Changes in Upland Forest Communities in Itasca State Park Over a 19-Year Period[1]

by

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INTRODUCTION

Itasca State Park is one of the most intensively investigated areas in Minnesota where ecological research and other biological studies have been conducted for many years, taking advantage of natural conditions of the park and the facilities of the University of Minnesota Forestry and Biological Station.

In general, the vegetation of Itasca Park shows the interaction of elements of mixed conifer-hardwood, deciduous, and boreal forests and the prairie. Closeness of the prairie is particularly indicated by the frequent summer drought periods.

The origin of present upland forest stands in the park was largely associated with past fires and logging. These stands have been subject to the process of post-fire stabilization in which fire protection has become an important factor in determining the future forest composition.

Mature and overmature stands of red pine (Pinus resinosa Ait.) and white pine (Pinus strobus L.) occupy a considerable part of the entire range of the upland forest complex. Young pine stands are almost absent. Overmature pines are gradually disappearing as a result of old age, windthrow and other causes. It has been apparent that pine seedlings, especially red pine, are present in extremely small numbers and rarely succeed in competition with other plants under existing stand and site conditions (Hansen and Duncan 1954, Kurmis 1969). Red and white pine stands were an important component of the presettlement forest and are of great aesthetic value for the park. Their continuity into the future is of concern to management and the public.

In the early studies by Bergman and Stallard (1916) red pine and white pine were considered as climax species in northern Minnesota. Lee (1924) emphasized the importance of fir-spruce in the park area and expected that Acer-Pinus strobus and Abies-Picea forests will develop concurrently. Kell (1938) stated that fir-spruce-birch on coarse-textured mineral soils and maple-basswood on fine-textured mineral soils can be considered as climax communities. In 1939, Buell and Gordon (1945) investigated a spruce-fir and maple-basswood forest contact zone in the park and concluded that spruce-fir is the more aggressive. In 1959, however, the main boundary between the maple-basswood and spruce-fir had shifted at the expense of the spruce-fir; in addition, young islands of maple-basswood had become established in the spruce-fir community. This was a reversal of the situation 20 years before (Buell and Martin 1961, Westman 1968).

Janssen (1967) recognized three "rich" deciduous and five "poor" coniferous types in the upland forest. All of the rich types revealed a close relationship to the mesic Tilia-Acer forest. He also mentioned a close relationship between Populus-Quercus and Pinus resinosa-P. banksiana forests. Abies balsamea forest was floristically related to the Pinus resinosa-P. banksiana forest and invariably overtopped by P. resinosa and P. strobus.

Other studies of stand structure and environmental conditions in different upland forest types have indicated that the most drastic change to occur within the next 25 years involves the pending areal reduction of aspen-birch cover type and the continuity of pines is pri-

marily limited to the remaining longevity of existing components (Ness 1971, Hansen et al. 1974).

Analyzing 26 years of change in a Pinus strobus, Acer saccharum forest in the park, Peet (1984) concluded that the stand development following loss of the pines is uncertain. According to him the most likely scenario is that the existing advanced regeneration of Acer, Tilia and Quercus will rapidly assume canopy dominance.

This study extends the previous knowledge in examining and describing the changes in tree density, composition and regeneration in 29 upland forest stands from 1965 to 1984. Based on these changes and considering tree species longevity, tolerance, regeneration habits, and edaphic conditions an attempt will be made to forecast the changes that will occur in the next 25 to 100 years assuming no severe disturbances in the park upland forest.

THE STUDY AREA

Itasca State Park encompasses 13,000 ha in northwestern Minnesota and lies in adjacent portions of Clearwater, Becker and Hubbard counties.

The park has a continental climate with temperature extremes of -44°C and 38°C, with 96 frost-free days, and with average annual precipitation of 666 mm (National Oceanic and Atmospheric Administration 1951-1984). More than half of the precipitation occurs during the summer months (May, June, July, August), with a maximum in June. Irregular drought periods of 10 to 30 days with little or no rainfall are characteristic during the growing season in the area. Figure 1 illustrates monthly average precipitation and temperature during the growing season (May, June, July, August) from 1955 to 1984.

The Itasca park area was glaciated in late-Wisconsin time, reflecting the activities of three ice lobes: Des Moines, Wadena and Rainy. The park lies in the area of the Itasca Moraine which was formed by a stillstand of the Wadena Lobe. According to Zumberge (1952) the retreat of the ice was slow, resulting in the hilly terminal moraine with many kettles now filled with lakes and bogs.

The upland soils in the park are derived from glacial and water deposited material, varying greatly in texture. They belong mainly to Nebish-Rockwood and Menahga-Marquette associations a classified by Arneman (1963). Nebish-Rockwood soils (boralfs) vary from coarse sandy loams to loams and clay loams. Marquette soils (boralfs) are formed in loam materials over calcareous gravel within 50 cm of the surface and

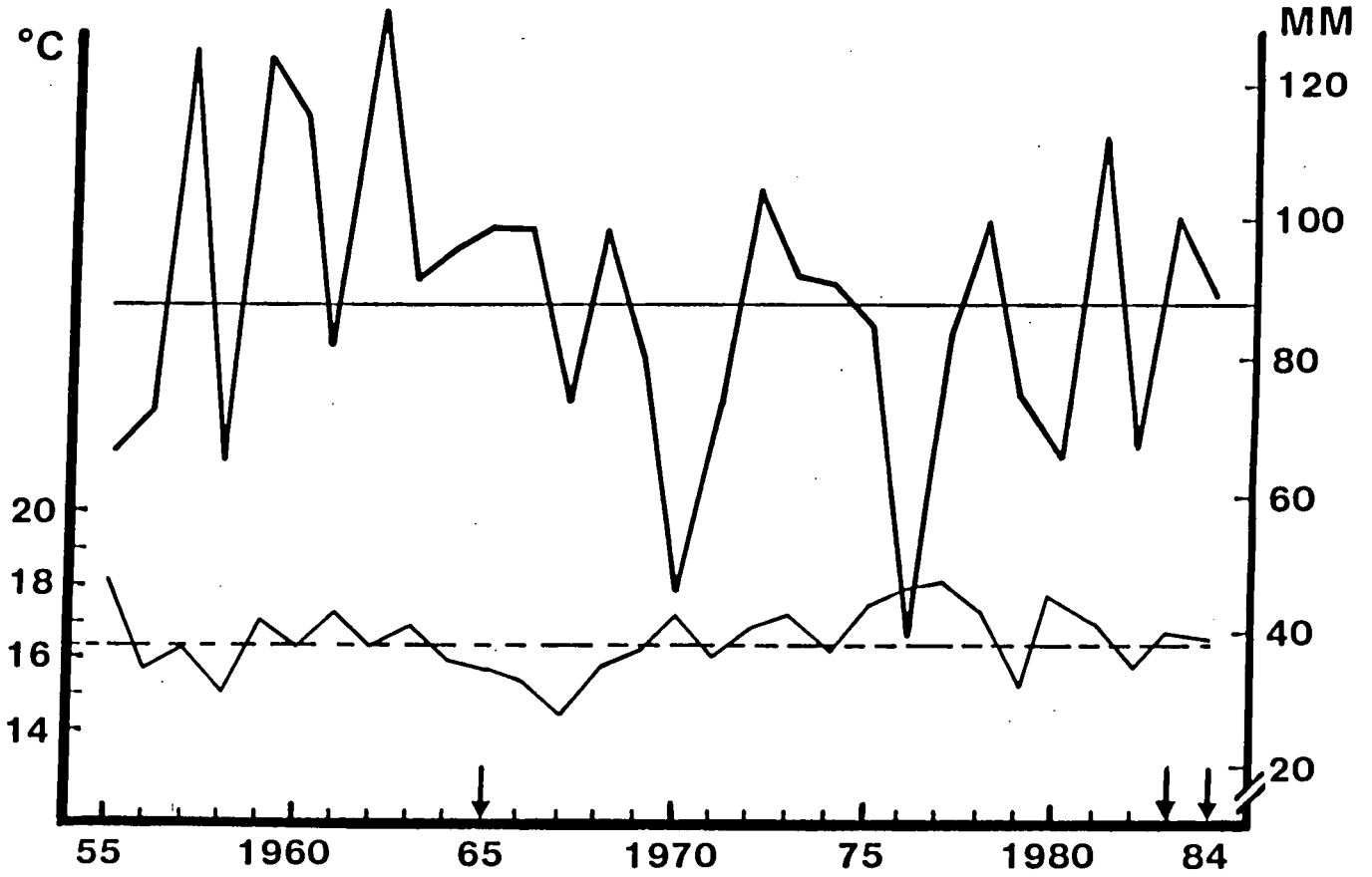

Figure 1. Monthly average precipitation and temperature during the growing season (May, June, July, August), 1955 to 1984 in Itasca State Park, Minnesota. The horizontal solid line is the 30-year (1951-1980) average precipitation. The dashed line is the 30-year average temperature. The arrows indicate the years of data collection.

are well drained. Less common Menahga soils (psamments) have developed in fine to medium outwash sands.

Both fires and logging have played important roles in the history of forest communities. Most of the park area was burned over several times during the 18th and 19th centuries favoring the less shade-tolerant species such as jack pine (Pinus banksiana Lamb.), red pine (Pinus resinosa Ait.), white pine (Pinus strobus L.), quaking aspen (Populus tremuloides Michx.), and paper birch (Betula papyrifera Marsh). Still today the park's forest vegetation is to a large extent in the post-fire and post-logging stabilization phase. According to the vegetation map of Itasca Park (Meyer 1966), the major forest cover type is aspen varying in composition from pure stands to those containing admixtures of paper birch, northern red oak (Quercus rubra L.), bur oak (Quercus macrocarpa Michx.), red maple (Acer rubrum L.), and other species. This type occurs over 6000 ha. Red pine occupies about 2000 ha jack pine about 600, and white pine about 500 ha. An additional 250 ha are classified as spruce-fir type, and contain white spruce (Picea glauca (Moench) Voss), balsam fir (Abies balsamea (L.) Mill.), aspen, paper birch and other species. Upland hardwoods occupy about 500 ha with sugar maple (Acer saccharum Marsh.), American basswood (Tilia americana L.), red maple, oaks, American elm (Ulmus americana L.) and ironwood (Ostrya virginiana (Mill.) K. Koch) as the most common species.

METHODS

In 1964, a reconnaissance survey was undertaken to determine the nature and range of the ecological conditions of the park's upland forest. Reconnaissance of a community included preparation of a plant list, estimation of the abundance of tree regeneration and shrubs, and measurement of tree ages, heights and diameters. Soil characteristics included texture, stoniness, depth and thickness of humus layer, and topographic features.

The method of synecological coordinates (Bakuzis 1959, Pluth and Arneman 1964, Bakuzis and Kurmis 1978) was used to organize the communities described in the reconnaissance. In essence, the method assumes that plant species found associated under conditions of natural competition are indicative of the prevailing community environment and can be used to assess the moisture, nutrient, heat and light conditions of forest ecosystems. Moisture and nutrient coordinate values were calculated for each community by averaging the moisture and nutrient values for all species on the plant list for the community.

Following the reconnaissance survey of 130 forest communities, 33 stands representing the apparent range of variability of upland moisture and nutrient conditions were selected for more intensive investigation. Selection of forest stands was primarily based on their moisture and nutrient coordinate values, tree species composition, stand age, and also geographic distribution. The minimum size of the stand area was about 8000 m^2.

The number, age and height of shrubs, tree seedlings and sprouts were determined on eight circular 8 m^2 plots randomly located and per-

manently established in each stand. Ground vegetation was recorded by species and cover percentages. Tree data collected included species and diameter, and age and height of trees representing each diameter class. The plot sizes were 200 or 400 m^2 and had the same plot centers as the 8 m^2 plots.

Two soil pits were dug in each stand, and soil profiles were described. The organic and mineral soil horizons were sampled for mechanical and chemical analysis of the soils.

The studied communities were grouped in six forest types: jack pine, jack pine-red pine, red pine, pine-spruce-fir, aspen-birch and maple-basswood. Forest type, as used in this study, reflects in the first place biologically effective moisture and nutrient intensities in a certain range. Type boundaries are adjusted to individual species distribution, overstory composition and soil characteristics. During the 19-year period three jack pine stands were lost to insect calamities and logging, resulting of poor representation of jack pine type. A white spruce community, planted 65 years ago, was left out from the present study, considering only 29 stands grouped in five forest types. Figure 2 and Appendix Table A shows the locations of studied stands in the park. Figure 3 depicts the stand and forest type locations in moisture and nutrient axes of the park upland forest.

In 1970 and 1975 data collection included measurements of shrubs, tree seedlings and sprouts, and herbaceous species on 8 m^2 plots. In 1983 and 1984 complete data collection was carried out including undergrowth and tree measurements. Tree ages and heights were determined only in 1965.

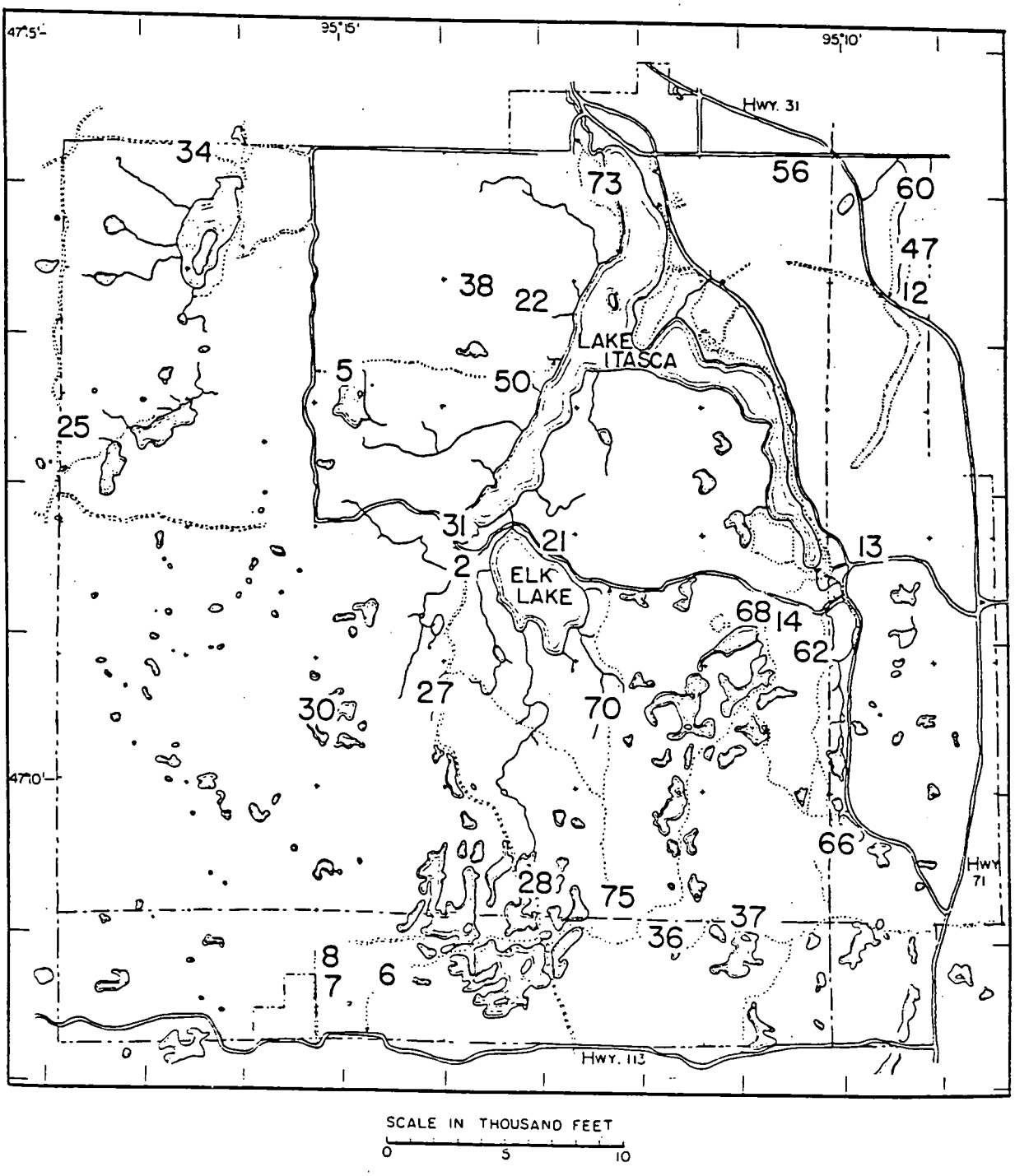

Figure 2. Location of 29 studied forest stands in Itasca State Park, Minnesota. 2-75 are the stand identification numbers.

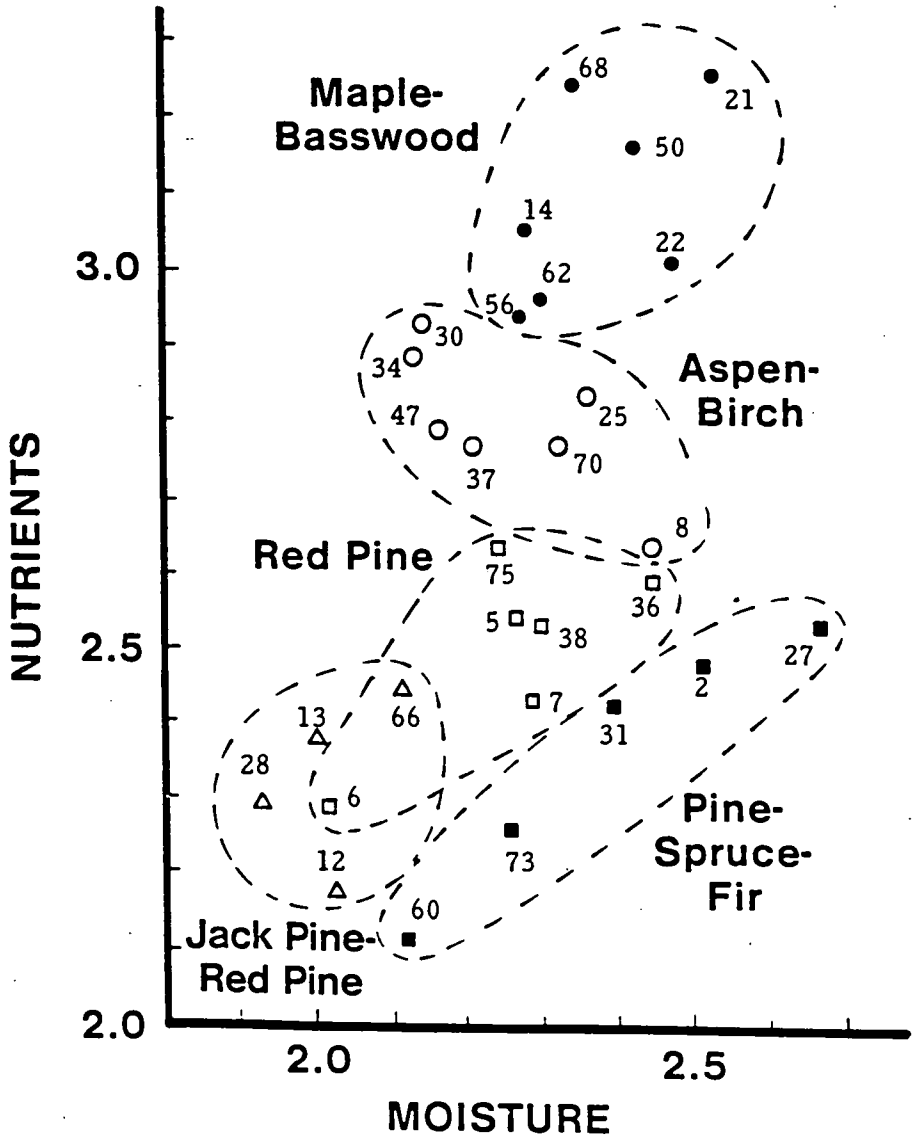

Figure 3. Location of 29 studied forest stands and five forest types in moisture and nutrient axes of the Itasca State Park upland forest.

LOCAL FOREST TYPES

An attempt was made to work out a local forest type classification of upland forests in the Itasca Park area. Synecological coordinates were used as an aid in the establishment of forest classification units.

Most of the upland forests in the park can be considered as temporary expressions or successional stages, mainly due to extensive fires in the past. They are still in process of post-fire stabilization. Most of the types represent ecological types in an unstable stage. Just how many units are to be recognized depends on practical considerations.

Figure 3 shows the five local forest types in the edaphic field. The names of these types indicate some of the dominant and/or associated tree species. The type names give some characteristics of the forest types but they do not define them in detail. Brief forest type descriptions, largely based on 1965 data, will follow.

Jack pine-red pine type. This type comprises mainly jack pine forests with various degrees of red pine admixture. White pine, quaking aspen, bigtooth aspen (Populus grandidentata Michx.), paper birch, bur oak, and red maple are the minor tree species. Soils represent a range from loamy coarse sands to gravelly sandy loams. They are somewhat excessively to well drained. Cobbles are common to abundant. Relief is nearly level to rolling.

White pine reproduction is scattered, only a few seedlings have exceeded 30 cm in height. Red pine and jack pine seedlings are practicaly absent. Red maple and red oak are the most prevalent of hardwood regeneration. Shrubs are abundant with beaked hazel (Corylus cornuta) as the predominant species.

Pine-spruce-fir type. This type includes pine-spruce-fir forests with red pine plus some white pine and paper birch as the overstory species. Balsam fir and white spruce are present to various degrees of density and composition in the understory. Paper birch is the most important hardwood species. Soils show a rather wide range of textural differences. They vary from sands to coarse sandy loams and loams. They are usually well drained with varying amounts of pebbles and cobbles. Relief is undulating to hilly.

Red pine and white pine seedlings are only of occasional occurrence. Balsam fir reproduction generally shows thrifty growth. Its distribution pattern is characterized by clustering. Hardwood reproduction is weakly developed of which red maple and black ash are the main representatives. The shrub layer is weakly developed. Beaked hazel, juneberry (Amelanchier spp.), and chokecherry (Prunus virginiana) are the major species of the tall shrub group. This type and the next discussed (red pine type) have some common features. The intensity of shrub development and the performance of balsam fir reproduction were used for establishing the final boundary.

Red pine type. Red pine forests are characteristic of this type. Quaking aspen and paper birch are the major hardwood representatives. Occurrence of oaks and red maple is scattered. White spruce and balsam fir are present in some communities. Balsam fir shows signs of decadence. Soils are well drained, loamy coarse sands to gravelly sandy loams and loams. Cobbles are common to abundant. Boulders are present. Relief is undulating to rolling.

White pine reproduction is scattered and shows poor growth performance. The same is true for balsam fir seedlings, although in some communities quite a few one-year old seedlings can be found. Red maple is the most aggressive of the hardwood reproduction followed by quaking aspen and red oak. Red maple seedlings constitute about 50 percent of the total hard wood reproduction. The shrub layer is well developed. Beaked hazel accounts for about 75 percent of the total number of shrubs. Being located in the central portion of the edaphic field, this type is related to jack pine-red pine and pine-spruce-fir types, and also with the next discussed type (aspen-birch type).

Aspen-birch type. This type includes mainly aspen and paper birch forests with red oak and bur oak admixture to a varying degree. Occasionally some white pines and red pines may be present. Soils are moderately well to well drained sandy loams to loams and sandy clay loams. Cobbles and boulders are occasional to common. Relief is undulating.

Conifer reproduction is almost non-existent. Red oak, red maple and quaking aspen reproduction is prevalent followed by black ash (Fraxinus nigra Marsh.), sugar maple, and American basswood. Shrubs are abundant. Beaked hazel, chokecherry, arrowwood (Viburnum rafinesquianum), round-leaved dogwood (Cornus rugosa), and juneberry are the most conspicuous. Beaked hazel accounts for over 50 percent of the total number of shrubs. This type shows some transitional features towards the next discussed type (maple-basswood).

Maple-basswood type. This type includes forests with rather advanced northern hardwood development. Sugar maple, red oak, and

American basswood are the most prevalent northern hardwood species. More or less open overstories usually consist of old growth aspen, white pine and bur oak. Soils are moderately well to well drained sandy loams to loams and silt loams. Cobbles and boulders are common. Relief is nearly level to rolling.

Sugar maple is by far the most abundantly reproducing species followed by red oak, red maple, ironwood, black ash and American basswood. White pine seedlings are present in considerable numbers, but survival and growth is poor. The shrub layer is weakly developed with beaked hazel, chokecherry, arrowwood, and mountain maple (Acer spicatum) being the most abundant species (Kurmis 1969).

CHANGES IN THE UPLAND FOREST

The change in abundance and diameter distribution patterns of individual tree species and groups of species will be discussed within the framework of the five upland forest types identified within the park. The basis for discussion will be the tree and tree reproduction data by individual tree species from 29 forest stands collected in 1965 and 1983/84 (Appendix Table B) and forest type summary data by species groups (Tables 1 to 5). In Appendix Table B stands are arranged by forest types and in the same sequence as indicated in the following discussion.

Jack Pine-Red Pine Type (stand no. 12, 13, 28 and 66).

Over an 18-year period, pines decreased in numbers by an average of 31 percent, varying in four stands from 23 to 49 percent (Table 1). The 90-year old jack pine showed the largest decrease in number of stems ranging from 48 to 57 percent in individual stands (Appendix Table B). Young pine saplings (2.5 to 7.5 cm in dbh) were absent. Aspen and paper birch decreased in numbers by 11 percent. However, the old tree attrition was partially balanced by patchwise ingrowth of young saplings in response to increased light through the deteriorating overstory. Oaks increased by 85 percent and red maple, ironwood and others by 270 percent.

The basal area of conifers, largely pines, decreased from 31.3 to 30.3 m^2/ha. The average type basal area of all species remained unchanged (Table 1).

Table 1. Number of trees by diameter classes and tree species groups and stand basal area of jack pine-red pine type in Itasca State Park in 1965 and 1983 or 1984.

Stand No.	Year	Pines			Spruce, Fir			Aspens, Birch			Oaks			Sugar maple, Basswood			Ashes, Elms			Red maple, Ironwood Others			All Species			basal area
		<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	m^2/ha
		stems/ha																							
12	1965	10	715	725	12	11	23	27	11	38	22		22							12		12	83	737	820	34.4
	1983		446	446	2	17	19	25	27	52	27	12	39							15	17	32	69	519	588	27.4
13	1965	44	773	817				64	29	93	7		7				2		2	22		22	139	802	941	32.2
	1984	19	609	628	2		2	30	31	61	27		27				2		2	27	14	41	107	654	761	35.9
28	1965	9	493	502	2		2	423	199	622	20	2	22	2		2	7		7	158	10	168	621	704	1325	28.3
	1983		256	256	7	2	9	332	335	667	59	27	86	42	9	51	49	2	51	468	119	587	957	750	1707	25.9
66	1965	64	1244	1308				14	240	254		53	53							7	7	14	85	1544	1629	45.1
	1984	7	980	987				14	107	121		41	41	7		7				136		136	164	1128	1292	51.4
Ave-	1965	32	806	838	3	3	6	132	120	252	12	14	26	1		1	2		2	50	4	54	232	947	1179	35.0
rage	1984	6	572	578	3	5	8	100	125	225	28	20	48	12	2	14	13	1	14	162	38	200	324	763	1087	35.1

Pine reproduction over 30 cm tall was absent in 1983. There were 115 white pine seedlings (up to 2.5 cm in dbh) per ha in this height class in 1965. Except for paper birch, other hardwoods such as aspen, oaks and red maple were less abundant in 1983 than in 1965. Hardwood seedlings and sprouts ranged from 110 to 980 stems per ha in 1983 (Appendix Table B).

Figure 4 illustrates the change in tree diameter distribution of the dominant jack pine and all species of stand no. 12, representing the jack pine-red pine type. The diameter distribution curves of jack pine are bell-shaped, typical for even-aged stands, with the 1983 diameter curve shifted toward larger diameters. Both curves culminate at 25 cm diameter class. The diameter curve of all species for 1983 is rather flat due to the addition of minor species in smaller diameter classes.

The red pine and white pine components in this type will become dominant species after jack pine deterioration. Canopy closure will be incomplete in many cases allowing hardwoods to fill in the gaps. Some jack pine relics and a few overmature jack pine individuals were found in old-growth red pine stands. This suggests that in the past some present day red pine stands were mixtures of jack and red pine.

Pine-Spruce-Fir-Type (stands no. 2, 27, 31, 60 and 73).

The 110 to 270 year old pines, largely red pines, decreased in numbers by 12 percent on the average. In five examined stands the mortality ranged from two to 22 percent. Except for new white pine saplings in stand no. 60, pine ingrowth was totally lacking (Table 2, Appendix Table B). Balsam fir and white spruce, largely balsam fir, increased by 93

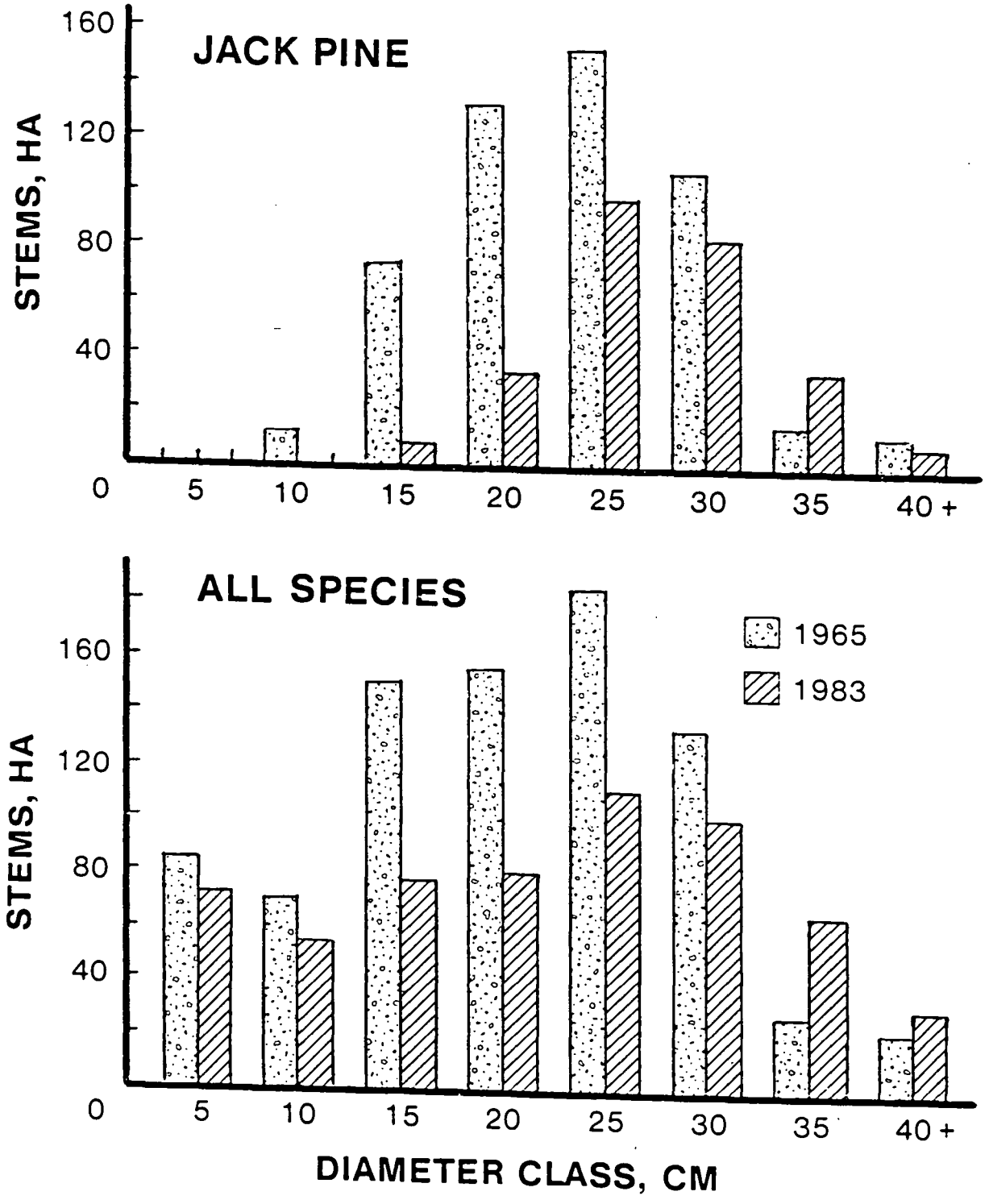

Figure 4. Number of dominant and all tree species by diameter classes. Jack pine - red pine type, stand no. 12, Itasca State Park in 1965 and 1983.

percent over the 18-year period. Balsam fir saplings (2.5 to 7.5 cm at dbh) in 1983 exceeded in numbers those measured in 1965 from four to 20 times. Aspen and paper birch showed 41 percent decrease in number of stems. Other hardwood species are sparse but there is a slight increase in their numbers as compared to 1965 (Table 2).

The basal area of pines increased from 28.5 to 31.0 m^2/ha and balsam fir and white spruce from 7.4 to 8.8 m^2/ha on the average. The overall increase in basal area was eight percent (Table 2, Appendix Table B).

Except for stand no. 60, pine reproduction over 30 cm tall, is largely absent. Numerous balsam fir seedlings from 1965 (7560 per ha on the average) were in the sapling stage in 1983. The 1983 balsam fir plus some white spruce seedling count was 1860 per ha. The hardwood seedlings and sprouts over 30 cm tall ranged from 30 to 980 per ha in 1965 and from 30 to 430 in 1983, with an increase in paper birch, a decrease in aspen and red maple, and remaining about the same in oaks and ashes (Appendix Table B).

Figure 5 shows the change in tree diameter distribution of the dominant red pine and all species for stand no. 31, representing the pine-spruce-fir type. The red pine diameter distribution curve is skewed toward larger diameters, especially in 1983. In 1965, the curve culminates at 25 cm, in 1983 at 40 cm diameter class. The diameter curve of all species, mostly balsam fir in addition to pine, indicates an uneven-aged stand. Large number of saplings in the 5 cm class is

Table 2. Number of trees by diameter classes and tree species groups and stand basal area of pine-spruce-fir type in Itasca State Park in 1965 and 1983 or 1984.

Stand No.	Year	Pines			Spruce, Fir			Aspens, Birch			Oaks			Sugar maple, Basswood			Ashes, Elms			Red maple, Ironwood Others			All Species			basal area
		<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	
		stems/ha																							m^2/ha
2	1965		96	96	541	956	1497		65	65											11	11	541	1128	1669	40.2
	1983		90	90	82	774	856		45	45											4	4	82	913	995	43.4
27	1965		146	146	131	622	753	37	252	289													168	1020	1188	49.0
	1983		133	133	560	275	835	7	101	108										12		12	579	507	1086	47.7
31	1965		354	354	84	269	353	64	76	140	2		2					2	2				150	701	851	35.7
	1983		307	307	677	197	874	27	71	98	2		2				2	2	4				708	577	1285	39.6
60	1965	130	569	699	158	6	164	69	44	113										9		9	366	619	985	31.4
	1983	257	430	687	1123	285	1408	101	57	158	7		7							14		14	1502	772	2274	36.6
73	1965	2	729	731	62	47	109	49	132	181							2		2				115	908	1023	37.7
	1984		569	569	1270	305	1575	15	41	56							32		32	2		2	1319	915	2234	42.7
Ave-	1965	26	379	405	195	380	575	44	114	158	+		+				+	+	1	2	2	4	268	875	1143	38.8
rage	1983	51	306	357	742	368	1110	30	63	93	2		2				7	+	7	6	1	7	838	737	1575	42.0

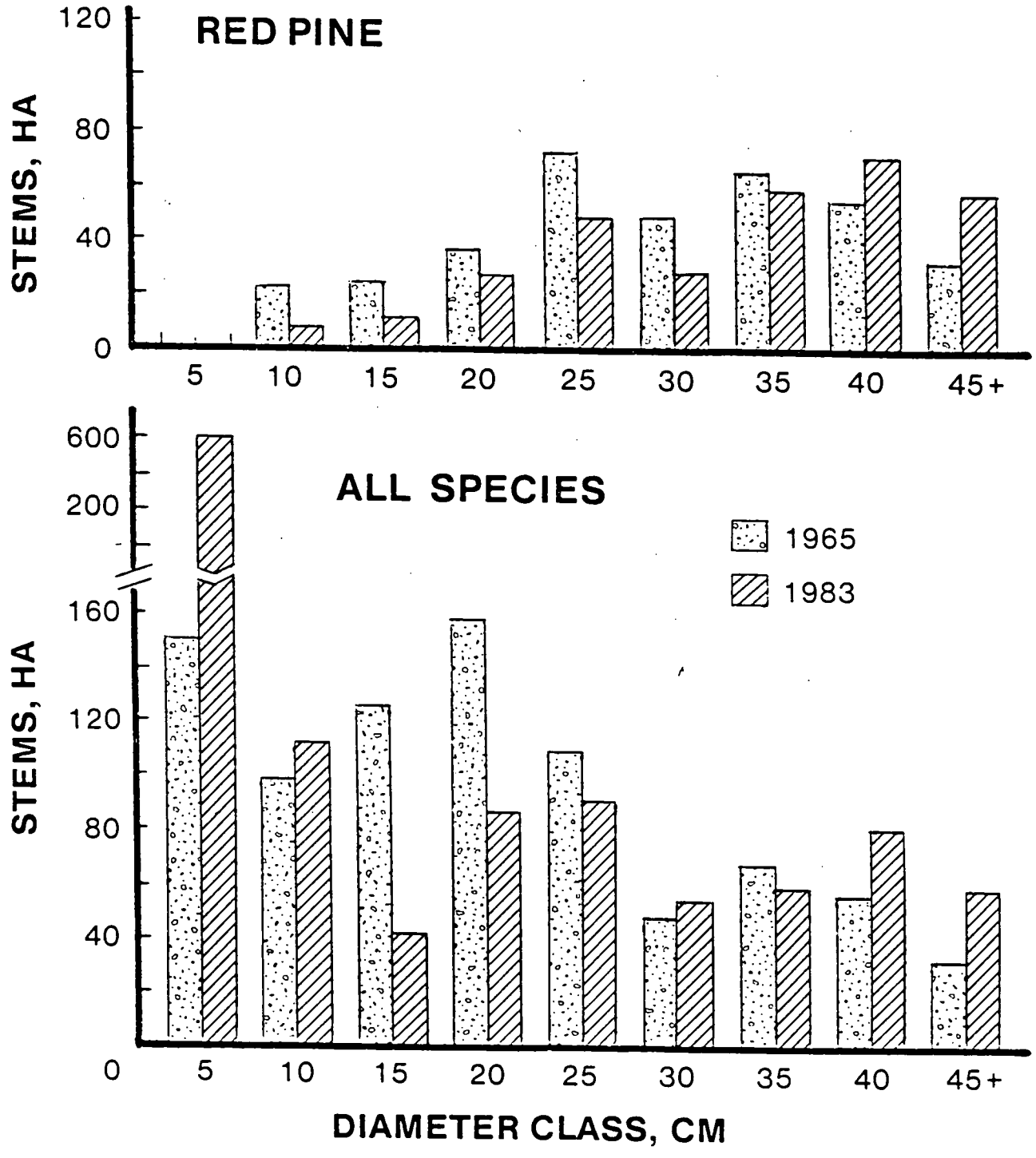

Figure 5. Number of dominant and all tree species by diameter classes. Pine-spruce-fir type, stand no. 31, Itasca State Park in 1965 and 1983.

shown in 1983, and a decrease in trees in mid-diameter classes as compared to 1965.

On moister, low nutrient upland sites balsam fir is a common understory to pine. In stands like number 31 in the pine-spruce-fir type the balsam fir understory has been perpetuating itself. By contrast, stand 38 in the red pine type on somewhat drier, richer site conditions the previous balsam fir understory has been replaced by hardwoods and shrubs. It is possible that with the disintegration of the pine overstory in the pine-spruce-fir type such sites will become warmer, drier and less suited to balsam fir and will also be replaced by hardwoods.

Red Pine Type (stand no. 5, 6, 7, 36, 38 and 75).

The 165 to 175 year old red pines have decreased in numbers on average of eight percent from 1965 to 1983, ranging from three to 11 percent in individual stands. On the average there were 268 pine trees per hectare. Pine saplings were absent (Table 3, Appendix Table B). The more or less scattered understory consists largely of aspens, paper birch, oaks, red maple and other hardwoods. The aspen and birch component decreased by 33 percent the oaks, red maple and other more tolerant hardwoods increased by 89 and 186 percent, respectively. Balsam fir and white spruce decreased by 77 percent, with very few stems in seedling and sapling stages in 1983 (Table 3, Appendix Table B).

Table 3. Number of trees by diameter classes and tree species groups and stand basal area of red pine type in Itasca State Park in 1965 and 1983 or 1984.

Stand No.	Year	Pines			Spruce, Fir			Aspens, Birch			Oaks			Sugar maple, Basswood			Ashes, Elms			Red maple, Ironwood Others			All Species			basal area
		<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	m^2/ha
		stems/ha																								
5	1965		432	432	2	14	16	40	34	74	99	14	113	2		2	14	4	18	123	4	127	280	502	782	43.5
	1983		395	395		2	2	22	33	55	156	54	210	12	2	14	59	4	63	222	83	315	471	573	1044	48.4
6	1965		345	345	10		10	59	50	109	22	4	26								2	2	91	401	492	38.2
	1983		315	315	2	9	11	42	66	108	77	4	81							10	2	12	131	396	527	41.3
7	1965		382	382				84	91	175	17	26	43							32		32	133	499	632	48.7
	1983		371	371	2		2	76	82	158	94	31	125				17		17	74	14	88	263	498	761	54.3
36	1965		119	119	4	80	84	220	110	330	15	2	17	2		2	2		2	195	8	203	438	319	757	40.8
	1983		106	106	2	68	70	74	100	174	24	22	46		2	2		2	2	307	135	442	407	435	842	41.3
38	1965		303	303	14	351	365		19	19													14	673	687	40.6
	1983		273	273	2	19	21	69	14	83	7		7				2		2	25		25	105	306	411	37.6
75	1965		162	162				141	586	727	39	98	137	7	2	9				138	23	161	325	871	1196	36.3
	1983		150	150	2		2	32	354	386	74	95	169	19		19	7		7	553	65	618	685	666	1351	39.3
Ave-	1965		291	291	5	74	79	91	148	239	32	24	56	2	+	2	3	1	4	81	6	87	214	544	758	41.4
rage	1983		268	268	2	16	18	53	108	161	72	34	106	5	1	6	14	1	15	199	50	249	345	478	823	43.7

The basal area of pines increased from 35.7 to 38.7 m^2/ha an increase of eight percent. Balsam fir and white spruce had a 53 percent decrease in basal area from 1.7 to 0.8 m^2/ha. The overall increase in basal area was six percent (Table 3, Appendix Table B).

Pine seedlings exceeding 30 cm in height were absent. In 1965 balsam fir seedlings taller than 30 cm were recorded in five of six stands. In 1983 they were present in only one stand. Hardwood seedlings and sprouts ranged from 150 to 1450 per ha in 1965 and from 30 to 950 per ha in 1983, red maple showing the highest densities (Appendix Table B).

Figure 6 depicts the change in tree diameter distribution of dominant red pine and all species of stand no. 5, representing the red pine type. The red pine diameter distribution curve is more skewed toward larger diameters than the red pine diameter distribution curve of stand no. 31 in the pine-spruce-fir type (Figure 5). The diameter distribution patterns of 1965 and 1983 are similar with a shift toward larger diameters in 1983, culminating at 40 cm diameter class as compared to 35 cm class in 1965. The all species diameter distribution curve shows stem culminations in 5 and 10 cm, and then again in 30 to 45 cm classes. All species diameter distribution of jack pine dominated stand no. 12 (Figure 4) showed quite different pattern probably due to younger age, greater stand density, and less hardwood trees in smaller diameter classes resulting in better expression of a bell-shaped curve than in the case of the old-growth red pine.

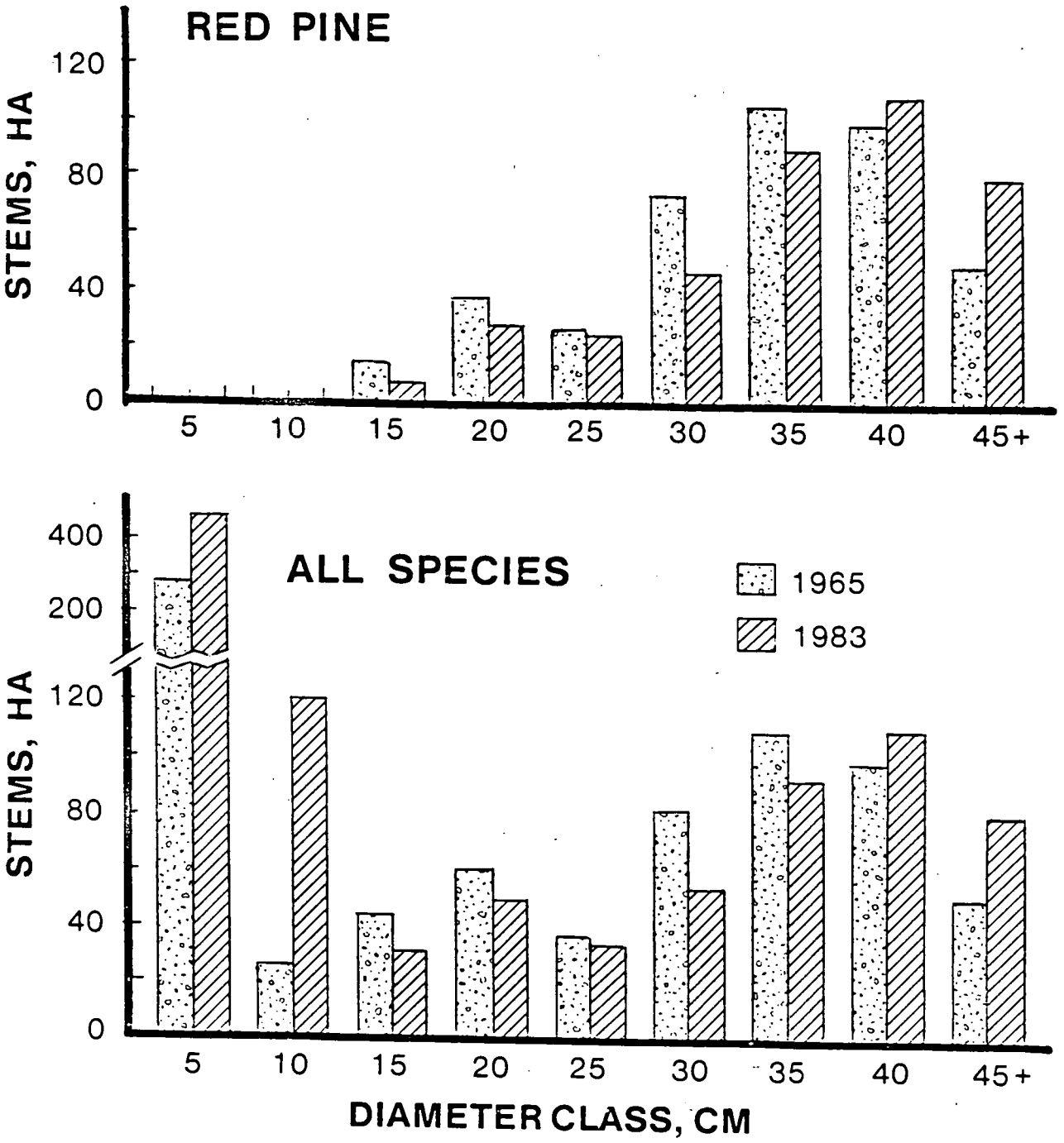

Figure 6. Number of dominant and all tree species by diameter classes. Red pine type, stand no. 5, Itasca State Park in 1965 and 1983.

The continuity of the red pines is primarily limited to the remaining longevity provided no drastic disturbance occurs. This means another 100 to 150 years. Assuming the present rate of decrease, eight percent in 20 years, there still could be about 170 trees per ha in 100 years, although with increased tree age one can expect an accelerated rate of deterioration. The 270-year old red pine stand (no. 27) in the pine-spruce-fir type had 133 trees per ha in 1983. In the last 18 years the balsam fir, aspen and birch components have sharply declined. There is no indication of balsam fir return with another wave of seedlings and saplings. Transitional hardwoods such as oaks, red maple and others have increased in numbers considerably. Encroachment by a few sugar maple and basswood new growth is noticeable.

Aspen-Birch Type (stand no. 8, 25, 30, 34, 37, 47 and 70)

Over a 19-year period, aspens and paper birch decreased in numbers by an average of 34 percent. Decrease in stems over 7.5 cm in diameter was 42 percent, indicating an ingrowth of young aspen saplings (Table 4). Aspen decreased from 527 to 381 stems per ha (28 percent) and paper birch from 380 to 209 stems per ha (45 percent). The increase in oaks, sugar maple and basswood, and red maple, ironwood and others was 40, 103 and 205 percent respectively (Table 4, Appendix Table B).

The basal area of aspens increased from 15.1 to 17.1 m^2/ha (13 percent). Paper birch showed a 14 percent decrease in basal area on the average, from 6.4 to 5.5 m^2/ha. The average type basal area increased by 12 percent (Table 4, Appendix Table B).

Table 4. Number of trees by diameter classes and tree species groups and stand basal area of aspen-birch type in Itasca State Park in 1965 and 1983 or 1984.

Stand No.	Year	Pines			Spruce, Fir			Aspens, Birch			Oaks			Sugar maple, Basswood			Ashes, Elms			Red maple, Ironwood Others			All Species			
		<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	basal area
		stems/ha																								m^2/ha
8	1965							39	760	799	25	38	63							49	19	68	113	817	930	29.4
	1984							44	446	490	37	40	77	7		7				44	64	108	132	550	682	34.5
25	1965							124	583	707	39	195	234	242	74	316	24	12	36	47	9	56	476	873	1349	25.9
	1984							17	385	402	49	171	220	404	187	591	12	16	28	116	33	149	598	792	1390	31.2
30	1965							19	1110	1129		107	107	56	14	70	7		7	76	34	110	158	1265	1423	28.8
	1984							57	689	746	37	100	137	56	56	112				312	75	387	462	920	1382	36.9
34	1965							81	748	829	27	127	154	4	2	6	2	7	9	17	2	19	131	886	1017	22.0
	1984							114	450	564	10	146	156	29	6	35	10	6	16	52	17	69	215	625	840	24.5
37	1965	25	389	414		2	2	27	420	447	10	81	91	40	44	84	2	12	14	42	7	49	146	955	1101	34.3
	1984	9	311	320	2	2	4	41	273	314	10	46	56	128	61	189	5	4	9	119	21	140	314	718	1032	39.8
47	1965							210	838	1048	19	13	32							10	10	20	239	861	1100	20.2
	1984							339	498	837	47	29	76					2	2	35	21	56	421	550	971	18.3
70	1965							74	1155	1229	39	28	67	14		14	7	7	14	44	7	51	178	1197	1375	30.3
	1984				12	20	32	193	524	717	235	90	325	44	20	64	99	14	113	217	27	244	800	695	1495	29.4
Ave-	1965	4	55	59		+	+	82	802	884	23	84	107	51	19	70	6	5	11	41	13	54	206	979	1185	27.3
rage	1984	1	45	46	2	3	5	115	466	581	61	89	150	95	47	142	18	6	24	128	37	165	420	693	1113	30.6

The hardwood saplings were more numerous in 1984 than in 1985, but hardwood seedlings and sprouts were less prevalent in 1984 as compared to 1965. Aspen and paper birch reproduction over 30 cm tall decreased from 1170 to 770 and 330 to 90 stems per ha, respectively. Oaks decreased from 860 to 220, red maple and ironwood from 1100 to 970, ashes and elms from 440 to 350 stems per ha. Only sugar maple and basswood reproduction, mainly sugar maple, increased from 530 to 1280 stems per ha.

Figure 7 illustrates the change in tree diameter distribution of the dominant aspens and all species of stand no. 70, representing the aspen-birch type. For the aspen overstory the diameter distribution curves are bell-shaped characteristic for even-aged stands, culminating at 15 cm diameter class in 1965 and at 25 cm class in 1984. The five cm class in 1984 of 115 stems per ha indicates the ingrowth during the 19-year period. The diameter distribution of all species has changed considerably toward an uneven-aged configuration. The heavy losses in smaller aspen diameter classes (15 cm class) have resulted in culminations of stems in five and 10 cm, and in 20 to 30 cm diameter classes.

The 70 to 80-year old aspens and paper birch are on a decline, and the even-aged overstories are deteriorating. Aspen saplings are present in stand openings along with other hardwood new growth. In the next generation aspen will be a stand component in a mixed hardwood forest. Paper birch saplings a basal sprouts are less common. All other hardwoods are more numerous in sapling sizes than 19 years ago. Sugar maple has increased in numbers as saplings and seedlings.

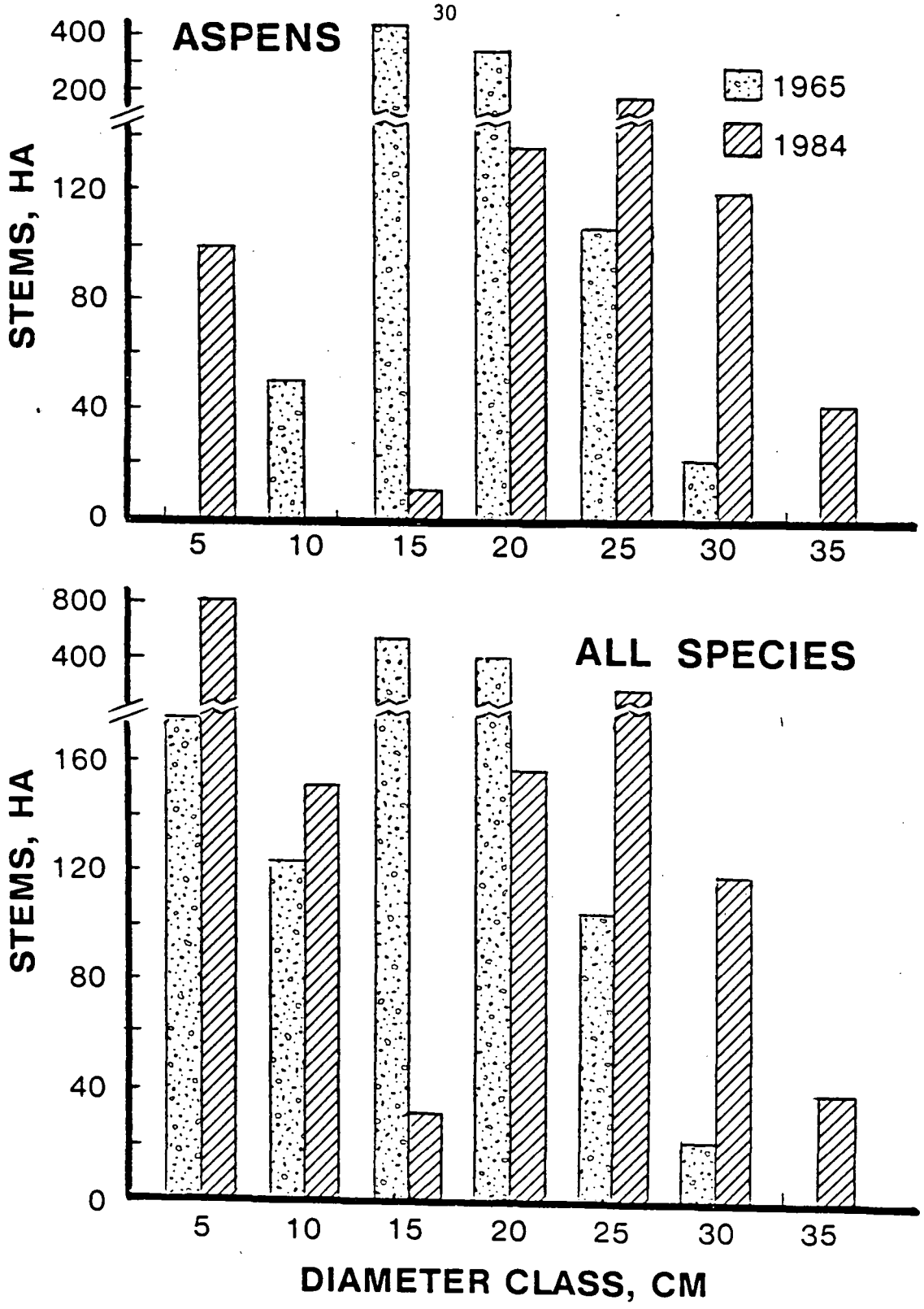

Figure 7. Number of dominant and all tree species by diameter classes. Aspen-birch type, stand no. 70, Itasca State Park in 1965 and 1984.

Maple-Basswood Type (stand no. 14, 21, 22, 50, 56, 62 and 68)

Emergent pines, largely white pines 150 to 200+ years old, above the hardwood canopy decreased in numbers by an average of 21 percent. The density of old-growth pines in the maple-basswood type ranged from two to 42 trees per ha in 1983/84. The 80 to 110 year old aspens and paper birch decreased in numbers by 35 and 46 percent. Ashes and elms, oaks, red maple and ironwood, and sugar maple and basswood also decreased in numbers by 19, 18, 12 and 4 percent, respectively. The three shade-tolerant northern hardwoods, sugar maple, basswood and ironwood, were reduced in total numbers by 2, 10 and 16 percent. The decrease in bur oak was twice as large as that of the red oak (Table 5, Appendix Table B).

The basal areas of pines, aspens, and paper birch decreased by 18, 29, and 18 percent, respectively. The average type basal area decreased by three percent (Table 5, Appendix Table B).

The hardwood reproduction over 30 cm tall was less numerous in 1984 than in 1965. Aspens, oaks, red maple and ironwood, and sugar maple and basswood decreased in numbers from 1170 to 280, 830 to 240, 8690 to 4990, and 22,240 to 19,710 stems per ha on the average. White pine reproduction over 30 cm tall was negligible (Appendix Table B).

Figure 8 shows the change in tree diameter distribution of the scattered aspen and birch overstory and all species of stand no. 14, representing the maple-basswood type. There is a noticeable shift toward larger tree diameters. The few aspen saplings in the 5 cm diameter class, came from stand no. 22, which is in an early stage of

Table 5. Number of trees by diameter classes and tree species groups and stand basal area of maple-basswood type in Itasca State Park in 1965 and 1983 or 1984.

Stand No.	Year	Pines			Spruce, Fir			Aspens, Birch			Oaks			Sugar maple, Basswood			Ashes, Elms			Red maple, Ironwood Others			All Species			
		<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	<7.5 cm	>7.5 cm	total	basal area
		stems/ha																								m^2/ha
14	1965							14	321	335	2	88	90	258	477	735		4	4	173	66	239	447	956	1403	35.0
	1984							2	194	196	2	74	76	183	459	642		2	2	369	82	451	556	811	1367	37.1
21	1965		4	4	10		10	2	137	139		17	17	131	467	598	2	89	91	771	49	820	916	763	1679	33.8
	1984				22		22		91	91		6	6	203	441	644	2	59	61	252	22	274	479	619	1098	33.7
22	1965		2	2	74	444	518	10	178	188	2	87	89	57	57	114	2	116	118	84	71	155	229	955	1184	35.2
	1984		2	2	20	167	187	141	102	243	2	83	85	344	70	414	17	95	112	304	90	394	828	609	1437	31.2
50	1965		30	30					156	156		41	41	228	645	873		9	9	10	28	38	238	909	1147	42.7
	1983		22	22					57	57		27	27	104	647	751		9	9	51	12	63	155	774	929	37.8
56	1965		48	48					115	115	2	217	219	186	526	712	2	6	8	262	83	345	452	995	1447	40.7
	1983		42	42					44	44		169	169	106	446	552		4	4	119	37	156	225	742	967	39.6
62	1965		9	9	2		2	2	283	285		87	87	210	449	659				59	79	138	273	907	1180	36.6
	1984		6	6	20	7	27		145	145		75	75	168	453	621				108	61	169	296	747	1043	35.1
68	1965		4	4				2	225	227		39	39	208	679	887		21	21	171	35	206	381	1003	1384	30.7
	1984		4	4					95	95		39	39	136	625	761		11	11	181	32	213	317	806	1123	33.5
Ave-	1965		14	14	12	63	75	4	202	206	1	82	83	183	471	654	1	35	36	219	59	278	419	927	1346	36.4
rage	1984		11	11	9	25	34	20	104	124	+	68	68	178	449	627	3	26	29	198	48	246	408	730	1138	35.4

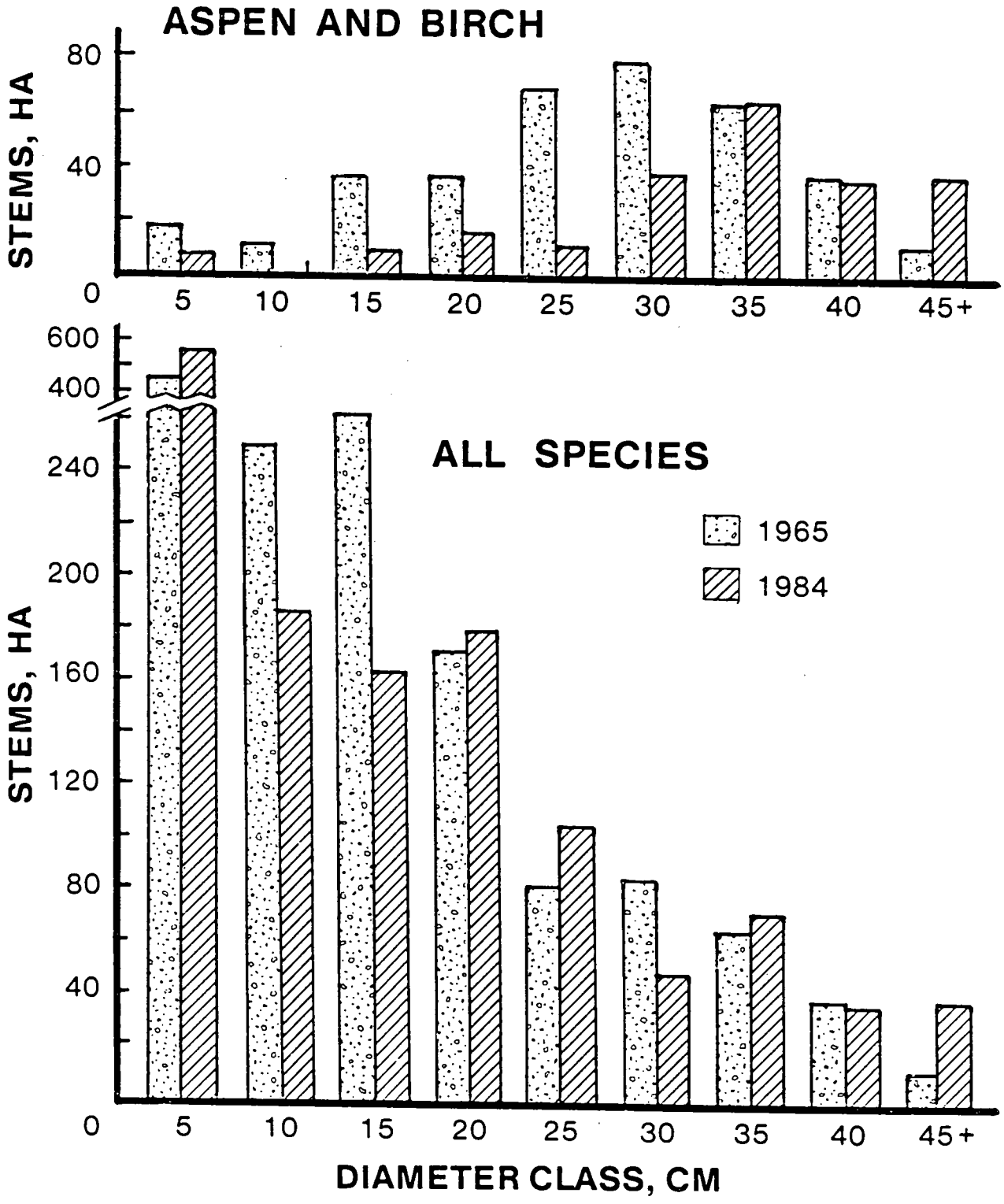

Figure 8. Number of dominant and all tree species by diameter classes. Maple-basswood type, stand no. 14, Itasca State Park in 1965 and 1984.

maple-basswood development. The diameter distribution of all species is typical of uneven-aged stands where shade-tolerant species predominate, and in characteristic of that of a near climax stand.

The attrition of old-growth pines in the maple-basswood type was twice of that in the red pine and pine-spruce-fir types over the 19-year period. This may indicate that scattered pines above the hardwood canopy are more vulnerable to windstorms than old growth pines forming a more closed upper canopy. The decrease in aspen and paper birch trees was twice as fast as that in pine, and similar to the decrease in aspen and paper birch in the aspen-birch type. The decrease in intermediate and even shade-tolerant species could be explained, at least partially, due to competition for space as individual trees grow and community develops. There is a range of successional developments among communities in this type, expressed in differences in species abundance and stand structure, some being in an early stage and others closer to what one perceives as a maple-basswood climax community.

Considering the pine, aspen and birch attrition rates and the lack of established seedlings and saplings of these species, the general successional trend is toward more shade-tolerant hardwood species such as sugar maple, basswood and ironwood, the latter being an understory species in the park.

SUMMARY

The jack pine dominated stands are rapidly deteriorating. Half of the overmature jack pines have died from 1965 to 1983. Admixture species such as red pine and white pine will become stand dominants forming an open main canopy. Young pine seedlings and saplings are absent. A lush growth of herbs, shrubs and hardwoods such as oaks, red maple and others will predominate in the undergrowth.

Old-growth pine attrition rate in the pine-spruce-fir type is moderate. Under pine canopies and under conditions of favorable moisture, balsam fir perpetuates itself in a patchwise pattern after parent trees are windthrown. The increase in shrubs and hardwoods is slight to moderate. After the deterioration of the pine overstory the presently suitable moisture and temperature conditions for balsam fir may change in favor of shrubs and hardwoods.

Mature to overmature red pines and white pines in the red pine type, predominantly 170 to 270 years old, are persisting with a minimum attrition over the last 18 years. Young pine growth is absent. The understory aspen and birch component is decreasing, while oaks, red maple and other hardwoods, and shrubs are increasing in abundance. Old-growth balsam fir, where present 18 years ago, has deteriorated with little reproduction extant.

The 70 to 80-year old aspen and paper birch communities are deteriorating. One-third to a half of the trees were lost in the last 19 years. Moderate occurrence of aspen saplings in stand openings may secure aspen as a stand component in a mixed hardwood forest in the next

generation. All other hardwoods are more numerous in sapling stage than 19 years ago. Sugar maple has increased in numbers in seedling and sapling stages.

In the maple-basswood type, the attrition rate of emergent old-growth pines above the hardwood canopy is higher than that in old-growth pines stands with rather closed canopies. The reduction in aspen and birch is high. Ashes and elms, oaks, red maple and ironwood also are decreasing in numbers probably due to increased competition for space. The decrease in sugar maple is slight. Considering the pine, aspen and birch attrition rates and the lack of established seedlings and saplings of these species, the general successional trend is toward more shade-tolerant hardwood species such as sugar maple, basswood and ironwood, the latter being an understory species in the park area.

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Appendix Table A. Locations of studied forest stands in Itasca State Park, Minnesota.

Stand No.	Section	T - N*	R - W**
2	NW 1/4 sec. 22	143	36
5	SW 1/4 " 9	143	36
6	SE 1/4 " 4	142	36
7	SW 1/4 " 4	142	36
8	NW 1/4 " 4	142	36
12	NW 1/4 " 7	143	35
13	NE 1/4 " 19	143	35
14	SE 1/4 " 24	143	36
21	NE 1/4 " 22	143	36
22	SE 1/4 " 3	143	36
25	NW 1/4 " 18	143	36
27	NE 1/4 " 28	143	36
28	SE 1/4 " 34	143	36
30	NW 1/4 " 28	143	36
31	SW 1/4 " 15	143	36
34	NW 1/4 " 5	143	36
36	NE 1/4 " 2	142	36
37	NW 1/4 " 1	142	36
38	SW 1/4 " 3	143	36
47	SE 1/4 " 6	143	35
50	SW 1/4 " 10	143	36
56	NE 1/4 " 1	143	36
60	NE 1/4 " 6	143	35
62	SE 1/4 " 24	143	36
66	NE 1/4 " 36	143	36
68	SW 1/4 " 24	143	36
70	NW 1/4 " 26	143	36
73	NW 1/4 " 2	143	36
75	SW 1/4 " 35	143	36

* Arkansas base line.

** 5th Principal meridian.

Appendix Table B. Number of trees by diameter classes, basal area, representative ages and heights, number of seedlings and sprouts by height classes in Itasca State Park in 1965 and 1983 or 1984.

Forest type: Jack pine-Red pine Stand No. 12

Species	Year	Diameter class (cm) 5	10	15	20	25	30	35	40	45	50	55	60	65	70	72.5+	Total	Basal area m^2/ha	Age* range years	Height* range m	Seedlings and Sprouts <30 cm	>30 cm	Total
		stems/ha																			stems/ha		
Pinus	1965		10	74	134	149	119	15	10		2						513	25.3	65-75,	11-25			
banksiana	1983			7	35	96	82	37	10								267	16.5	140				
Pinus	1965	10	37	62	12	15	12	12		2			7				169	7.0	65-75,	6-22			
resinosa	1983		15	27	37	12	12	22	10	7	2						144	8.1	235				
Pinus	1965		10	12	7	12	2										43	1.4	65-75	9-21	460	310	770
strobus	1983			12	7	2	7	7									35	1.7			150		150
Picea	1965	12	2		2	7											23	.5	30-75	3-15	150		150
glauca	1983	2	10	7													19	.2					
Betula	1965	20	7	2													29	.1	25-75	5-14	150		150
papyrifera	1983	25	10	15													50	.4					
Populus	1965	7	2														9	+	15-25	5-9			
tremuloides	1983		2														2	+					
Quercus	1965	22															22	+	30-35	3-6			
macrocarpa	1983	7	10														17	.1					
Quercus	1965																—						
rubra	1983	20	2														22	.1			150		150
Acer	1965	12															12	+	20-25	2-5	150	150	300
rubrum	1983	15	7	10													32	.3			2320	150	2470
Conifers	1965	22	59	148	155	183	133	27	10	2	2		7				748	34.2			610	310	920
	1983	2	25	53	79	110	101	66	20	7	2						465	26.5			150		150
Hardwoods	1965	61	9	2													72	.2			300	150	450
	1983	67	31	25													123	.9			2470	150	2620
Total	1965	83	68	150	155	183	133	27	10	2	2		7				820	34.4			910	460	1370
	1983	69	56	78	79	110	101	66	20	7	2						588	27.4			2620	150	2770

* Age and height determined only in 1965.

Appendix Table B. (Continued)

Forest type: Jack Pine-Red Pine Stand No. 13

Species	Year	Diameter class (cm) 5	10	15	20	25	30	35	40	45	50	55	60	65	70	72.5+	Total	Basal area m^2/ha	Age* range years	Height* range m	Seedlings and Sprouts <30 cm	>30 cm	Total
		stems/ha																			stems/ha		
Pinus	1965			27	114	89	99	25	2								356	18.5	70-80	13-24			
banksiana	1984	2			20	27	59	44		2							154	11.0					
Pinus	1965	44	131	62	59	37	27	25	10								395	11.2	65-80	5-23			
resinosa	1984	17	91	82	32	64	40	40	17	17							400	20.6					
Pinus	1965		10	22	12	20			2								66	2.1	70-80	9-21	150	150	300
strobus	1984			25	2	17	20	10									74	3.6			400		400
Picea	1965																-						
glauca	1984	2															2	+					
Betula	1965	32	20	2													54	.2	20-35	5-12			
papyrifera	1984	10	17	10													37	.3					
Populus	1965	32			7												39	.2	15-20,80	5-17			
tremuloides	1984	20			2	2											24	.3					
Quercus	1965	7															7		15-35	3-4			
macrocarpa	1984	17															17	+					
Quercus	1965																-				150		150
rubra	1984	10															10	+			200	200	400
Acer	1965	20															20	+	20-35	5-10			
rubrum	1984	27	10	2													39	.1			1640		1640
Ulmus	1965	2															2		30	9			
americana	1984	2															2	+					
Prunus	1965	2															2		25			150	150
serotina	1984		2														2	+			420	200	620
Conifers	1965	44	141	111	185	146	126	50	14								817	31.8			150	150	300
	1984	21	91	107	54	108	119	94	17	19							630	35.2			400		400
Hardwoods	1965	95	20	2	7												125	.4			150	150	300
	1984	86	29	12	2	2											131	.7			2260	400	2660
Total	1965	139	161	113	192	146	126	50	14								941	32.2			300	300	600
	1984	107	120	119	56	110	119	94	17	19							761	35.9			2660	400	3060

* Age and height determined only in 1965.

Appendix Table B. (Continued)

Forest type: Jack Pine-Red Pine Stand No. 28

Species	Year	Diameter class (cm) 5	10	15	20	25	30	35	40	45	50	55	60	65	70	72.5+	Total	Basal area m^2/ha	Age* range years	Height* range m	Seedlings and Sprouts <30 cm	>30 cm	Total
		stems/ha																				stems/ha	
Pinus	1965	2	10	57	188	183	44	7									491	20.0	65-75	14-23			
banksiana	1983			10	62	99	64	12	7								254	14.1					
Pinus	1965	7								2	2						11	1.1	160-165	21-22			
resinosa	1983										2						2	.7					
Pinus	1965																-				1230		1230
strobus	1983																-						
Picea	1965	2															2		30	3		150	150
glauca	1983	7	2														9	+					
Betula	1965	32	7	2													41	.1	15-40	4-13		150	150
papyrifera	1983	49	27	2	7												85	.6			150	310	460
Populus	1965	332	12	32	44	74	2										496	6.3	20-75	5-22		1850	1850
tremuloides	1983	268	144	15	20	35	44	2									528	7.7			620	620	1240
Populus	1965	59	12	7		7											85	.5	20-75	5-20			
grandidentata	1983	15	27	10		2											54	.6					
Quercus	1965		2														2	+	65	6		150	150
macrocarpa	1983	22		2													24	.1					
Quercus	1965	20															20	+	25-30	4	310	460	770
rubra	1983	37	25														62	.3			620	460	1080
Acer	1965	7															7		20	4	460	770	1230
rubrum	1983	69	10														79	.2			3700	150	3850
Acer	1965																-						
saccharum	1983	15															15	+			310	150	460
Tilia	1965	2															2		25	4	150		150
americana	1983	27	7		2												36	.2			150		150
Ostrya	1965	151	10														161	.3	30-60	5-9			
virginiana	1983	397	109														506	1.3					
Fraxinus	1965	7															7		25	4		150	150
pennsylvanica	1983	49	2														51	.1					
Prunus	1965																-						
serotina	1983	2															2	+					
Conifers	1965	11	10	57	188	183	44	7		2	2						504	21.1			1230	150	1380
	1983	7	2	10	62	99	64	12	7		2						265	14.8					
Hardwoods	1965	610	43	41	44	81	2										821	7.2			920	3530	4450
	1983	950	351	29	29	37	44	2									1442	11.1			5550	1690	7240
Total	1965	621	53	98	232	264	46	7		2	2						1325	28.3			2150	3680	5830
	1983	957	353	39	91	136	108	14	7		2						1707	25.9			5550	1690	7240

* Age and height determined only in 1965.

Appendix Table B. (Continued)

Forest type: Jack Pine-Red Pine Stand No. 66

Species	Year	Diameter class (cm) 5	10	15	20	25	30	35	40	45	50	55	60	65	70	72.5+	Total	Basal area m^2/ha	Age* range years	Height* range m	Seedlings and Sprouts <30 cm	>30 cm	Total
		stems/ha																				stems/ha	
Pinus resinosa	1965	12	131	310	268	193	62	32									1008	32.4	60-75	7-22			
	1984		37	94	173	206	181	62	25								778	39.4					
Pinus strobus	1965	52	106	74	40	12	7	2	7								300	5.8	60-75	5-24	1850		1850
	1984	7	69	62	20	32	12				7						209	5.6					
Betula papyrifera	1965	7	57	124	25	7											220	3.7	60-75	12-19	150	1240	1390
	1984	7		37	32	12											88	2.4				310	310
Populus tremuloides	1965	7			7	20											34	1.3	20,70-75	4-20	1080	2630	3710
	1984	7				7	12	7									33	1.8			770	1240	2010
Populus grandidentata	1965																-					150	150
	1984																-						
Quercus rubra	1965		10	7	7	22	7										53	1.8	70-75	11-19	2010	1540	3550
	1984			7		20	7	7									41	2.1			1700	460	2160
Acer rubrum	1965	7	7														14	.1	25	4-12	8800	3860	12660
	1984	111															111	.1			4320	3400	7720
Acer saccharum	1965																-						
	1984	7															7	+				310	310
Ostrya virginiana	1965																-					310	310
	1984	25															25	+					
Conifers	1965	64	237	384	308	205	69	34	7								1308	38.2			1850		1850
	1984	7	106	156	193	238	193	62	25		7						987	45.0					
Hardwoods	1965	21	74	131	39	49	7										321	6.9			12040	9730	21770
	1984	157		44	32	39	19	14									305	6.4			6790	5720	12510
Total	1965	85	311	515	347	254	76	34	7								1629	45.1			13890	9730	23620
	1984	164	106	200	225	277	212	76	25		7						1292	51.4			6790	5720	12510

* Age and height determined only in 1965.

Appendix Table B. (Continued)

Forest type: Pine-Spruce-Fir Stand No. 2

Species	Year	Diameter class (cm) 5	10	15	20	25	30	35	40	45	50	55	60	65	70	72.5+	Total	Basal area m^2/ha	Age* range years	Height* range m	Seedlings and Sprouts <30 cm	>30 cm	Total
									stems/ha													stems/ha	
Pinus resinosa	1965					7	12	7	15	20	12	7	2	10			92	15.4	145-155	17-27			
	1983					2	2	12	7	12	22	10	7	2	10		86	17.2					
Pinus strobus	1965												2		2		4	2.0	145	24-26			
	1983												2		2		4	2.0			1240		1240
Abies balsamea	1965	15	2	2	10	12	2		2								45	1.6	30-80	3-23	3090		3090
	1983	10	2	2		7	2	2									25	.9			9880		9880
Picea glauca	1965	526	430	262	158	64	12										1452	17.7	25-55	4-19		150	150
	1983	72	259	180	158	101	49	12									831	20.2					
Betula papyrifera	1965			12	25	12	10										59	2.1	50-80	11-19			
	1983			2	12	20	7										41	1.8					
Populus tremuloides	1965				2					2							4	.6	50	14-21	150	620	770
	1983					2					2						4	.8			460	620	1080
Populus grandidentata	1965						2										2	.2					
	1983																-						
Populus balsamifera	1965			2		2	7										11	.6	90	15-20			
	1983						2	2									4	.5			310	150	460
Quercus rubra	1965																-				460		460
	1983																-				620	150	770
Fraxinus nigra	1965																-				310		310
	1983																-				310	310	620
Conifers	1965	541	432	264	168	83	26	7	17	20	12	7	4	10	2		1593	36.7			3090	150	3240
	1983	82	261	182	158	110	53	26	7	12	22	10	9	2	12		946	40.3			11120		11120
Hardwoods	1965			14	27	14	19			2							76	3.5			920	620	1540
	1983			2	12	22	9	2			2						49	3.1			1700	1230	2930
Total	1965	541	432	278	195	97	45	7	17	22	12	7	4	10	2		1669	40.2			4010	770	4780
	1983	82	261	184	170	132	62	28	7	12	24	10	9	2	12		995	43.4			12820	1230	14050

* Age and height determined only in 1965.

Appendix Table B. (Continued)

Forest type: Pine-Spruce-Fir Stand No. 27

Species	Year	Diameter class (cm) 5	10	15	20	25	30	35	40	45	50	55	60	65	70	72.5+	Total	Basal area m^2/ha	Age* range years	Height* range m	Seedlings and Sprouts <30 cm	>30 cm	Total
		stems/ha																			stems/ha		
Pinus	1965				2		2		10	15	15	37	10	32	2	12	137	36.2	200-255	14-34	150		150
resinosa	1983				2		2		2	10	20	20	25	15	22	15	133	38.9					
Pinus	1965		7		2												9	.1	65-75	10-15			
strobus	1983																-				310		310
Abies	1965	96	220	181	49	15											561	7.3	65-75	3-20	15740	4780	20520
balsamea	1983	558	57	94	49	22	7										787	6.2			2620	4630	7250
Picea	1965	35	86	69	2												192	2.0	50-75	5-14			
glauca	1983	2	22	22	2												48	.7			150		150
Betula	1965	37	171	57	15	7	2										289	3.4	45-75	8-22			
papyrifera	1983	7	35	32	22	10											106	1.9			3090	1080	4170
Acer	1965																-				16200	4320	20520
rubrum	1983	12															12	+			5400	2010	7410
Acer	1965																-				150		150
saccharum	1983																-						
Fraxinus	1965																-						
nigra	1983																-				620		620
Conifers	1965	131	313	250	55	15	2		10	15	15	37	10	32	2	12	899	45.6			15840	4780	20670
	1983	560	79	116	53	22	9		2	10	20	20	25	15	22	15	968	45.8			3080	4630	7710
Hardwoods	1965	37	171	57	15	7	2										289	3.4			16350	4320	20670
	1983	19	35	32	22	10											118	1.9			9110	3090	12200
Total	1965	168	484	307	70	22	4		10	15	15	37	10	32	2	12	1188	49.0			32240	9100	41340
	1983	579	114	148	75	32	9		2	10	20	20	25	15	22	15	1086	47.7			12190	7720	19910

* Age and height determined only in 1965.

Appendix Table B. (Continued)

Forest type: Pine-Spruce-Fir Stand No. 31

Species	Year	Diameter class (cm) 5	10	15	20	25	30	35	40	45	50	55	60	65	70	72.5+	Total	Basal area m^2/ha	Age* range years	Height* range m	Seedlings and Sprouts <30 cm	>30 cm	Total
		stems/ha																				stems/ha	
Pinus	1965			2		7		7									16	1.0	100-155	13-22			
banksiana	1983			2		2		2									6	.6					
Pinus	1965		22	22	37	64	49	57	57	20	10						338	25.9	100-155	13-26		150	150
resinosa	1983		7	10	27	47	27	57	69	35	15	7					301	29.8					
Pinus	1965																-					150	150
strobus	1983																-				460		460
Abies	1965	77	49	96	94	15	2	2									335	6.3	25-100	3-20	17900	19290	37190
balsamea	1983	642	72	27	37	37	10			2							827	6.4			3240	3550	6790
Picea	1965	7		7	2	2											18	.3	25-100	3-19			
glauca	1983	35	10		2												47	.2			310		310
Betula	1965	64	25	2	27	22											140	2.2	20-155	3-20			
papyrifera	1983	27	22		22	7	20										98	2.6			3400	770	4170
Quercus	1965	2															2	+	30	4			
macrocarpa	1983	2															2	+					
Acer	1965																-				150	460	610
rubrum	1983																-				930	150	1080
Ulmus	1965		2														2	+	25	6			
americana	1983			2													2	+					
Fraxinus	1965																-				150	460	610
nigra	1983	2															2	+			930		930
Conifers	1965	84	71	127	133	88	51	66	57	20	10						707	33.5			17900	19590	37490
	1983	677	89	39	66	86	37	59	69	37	15	7					1181	37.0			4010	3550	7560
Hardwoods	1965	66	27	2	27	22											144	2.2			300	920	1220
	1983	31	22	2	22	7	20										104	2.6			5260	920	6180
Total	1965	150	98	129	160	110	51	66	57	20	10						851	35.7			18200	20510	38710
	1983	708	111	41	88	93	57	59	69	37	15	7					1285	39.6			9270	4470	13740

* Age and height determined only in 1965.

Appendix Table B. (Continued)

Forest type: Pine-Spruce-Fir Stand No. 60

Species	Year	Diameter class (cm) 5	10	15	20	25	30	35	40	45	50	55	60	65	70	72.5+	Total	Basal area m^2/ha	Age* range years	Height* range m	Seedlings and Sprouts <30 cm	>30 cm	Total
		stems/ha																				stems/ha	
Pinus banksiana	1965	2	27	124	114	57	22	7									353	10.9	65-75	5-23		150	150
	1983		2	32	52	69	44	10									209	9.8					
Pinus resinosa	1965	101	77	20	10	2	2	7	7	40	12	20					298	16.7	60-75	6-25		2930	2930
	1983	47	57	40	12	10	10	2	10	15	27	15	10				255	18.9	130-165				
Pinus strobus	1965	27	10	2							7				2		48	2.7	20-70	3-29	1080	4630	5710
	1983	210	7	2					2							2	223	2.2	155		520	360	880
Abies balsamea	1965	99															99	.1	15-25	3-5	1230	8180	9410
	1983	1049	210	2													1261	3.4			710	520	1230
Picea glauca	1965	59	2		2	2											65	.4	25-70	3-18		460	460
	1983	74	52	10	7	2		2									147	1.2					
Betula papyrifera	1965	69	32	10	2												113	.6	20-70	4-19			
	1983	101	25	20	10	2											158	1.1					
Quercus rubra	1965																-						
	1983	7															7	+			460		460
Acer rubrum	1965	2															2	+	20	3			
	1983	2															2	+			360		360
Prunus serotina	1965	7															7	+	25-30				
	1983	12															12	+					
Conifers	1965	288	116	146	126	61	24	14	7	40	19	20			2		863	30.8			2310	16350	18660
	1983	1380	328	86	71	81	54	14	12	15	27	15	10			2	2095	35.5			1230	880	2110
Hardwoods	1965	78	32	10	2												122	.6					
	1983	122	25	20	10	2											179	1.1			820		820
Total	1965	366	148	156	128	61	24	14	7	40	19	20			2		985	31.4			2310	16350	18660
	1983	1502	353	106	81	83	54	14	12	15	27	15	10			2	2274	36.6			2050	880	2930

* Age and height determined only in 1965.

Appendix Table B. (Continued)

Forest type: Pine-Spruce-Fir Stand No. 73

Species	Year	Diameter class (cm) 5	10	15	20	25	30	35	40	45	50	55	60	65	70	72.5+	Total	Basal area m^2/ha	Age* range years	Height* range m	Seedlings and Sprouts <30 cm	>30 cm	Total
		stems/ha																			stems/ha		
Pinus resinosa	1965		25	22	35	49	89	52	7	2							281	17.3	80-90	9-22			
	1984		7	7	15	37	47	99	25	10	2						249	20.9					
Pinus strobus	1965	2	77	131	121	74	25	20									450	14.3	80-90	9-21	620		620
	1984		15	72	77	77	47	22	10								320	14.5			310		310
Abies balsamea	1965	62	7	7	10												86	.5	25-30	3-17	1540	4940	6480
	1984	1260	297														1557	4.2	75-85		460	620	1080
Picea glauca	1965		7	2	7	7											23	.6	80-85	6-16			
	1984	10		2	2	2		2									18	.6					
Betula papyrifera	1965			32	40	25	10	2									109	4.0	80-90	15-22	310		310
	1984			2	10	12	15	2									41	2.5			930		930
Populus tremuloides	1965	49			7	7	7										70	1.0	15-25	4-19	150	1080	1230
	1984	15															15	+	90				
Populus grandidentata	1965			2													2	+		15			
	1984																-						
Quercus macrocarpa	1965																-					150	150
	1984																-						
Fraxinus pennsylvanica	1965	2															2	+	20	4	150	150	300
	1984	32															32	+			1540	310	1850
Prunus serotina	1965																-					150	150
	1984	2															2	+					
Conifers	1965	64	116	162	173	130	114	72	7	2							840	32.7			2160	4940	7100
	1984	1270	319	81	94	116	94	123	35	10	2						2144	40.2			770	620	1390
Hardwoods	1965	51		34	47	32	17	2									183	5.0			610	1530	2140
	1984	49		2	10	12	15	2									90	2.5			2470	310	2780
Total	1965	115	116	196	220	162	131	74	7	2							1023	37.7			2770	6470	9240
	1984	1319	319	83	104	128	109	125	35	10	2						2234	42.7			3240	930	4170

* Age and height determined only in 1965.

Appendix Table B. (continued).

Forest type: Red pine Stand No. 5

Species	Year	Diameter class (cm) 5	10	15	20	25	30	35	40	45	50	55	60	65	70	72.5+	Total	Basal area m^2/ha	Age* range years	Height* range m	Seedlings and Sprouts <30 cm	>30 cm	Total
		stems/ha																			stems/ha		
Pinus resinosa	1965			12	35	25	72	106	99	37	10						396	38.6	140-160	15-30			
	1983			2	27	20	44	89	106	62	15	2					367	41.4					
Pinus strobus	1965				10	10	10	2	2					2			36	3.2	140-160	17-31	310		310
	1983				2	10	10	2	2					2			28	3.5			150		150
Abies balsamea	1965	2		10	2												14	.2	25-85	3-14	150	150	300
	1983				2												2	.1			150		150
Picea glauca	1965				2												2	.1					
	1983																—						
Betula papyrifera	1965	40	15	7	10												72	.6	25-100	6-17			
	1983	22	12	12	7	2											55	.7					
Populus tremuloides	1965		2														2	+	50	7			
	1983																—						
Quercus macrocarpa	1965	52	2	2													56	.2	30-100	5-12		150	150
	1983	99	15	7													121	.4					
Quercus rubra	1965	47		10													57	.2	30-100	5-12			
	1983	57	22		10												89	.5			150		150
Acer rubrum	1965	106	2	2													110	.2	25-65	5-12	2620	1080	3700
	1983	210	62	7	2												281	1.0			3860	150	4010
Ostrya virginiana	1965	15															15	+	25-45	4-7			
	1983	12	10														22	.1			310	310	620
Tilia americana	1965	2															2	+	25	4			
	1983	2	2														4	+					
Ulmus americana	1965	2	2		2												6	.1		4-12			
	1983	10		2				2									14	.4					
Fraxinus nigra	1965	12															12	+			2160	620	2780
	1983	49															49	.1			1390	620	2010
Prunus serotina	1965	2															2	+		5			
	1983		2														2	+					
Acer saccharum	1965																—						
	1983	10															10	+					
Conifers	1965	2		22	49	35	82	108	101	37	10			2			448	42.1			460	150	610
	1983			2	31	30	54	91	108	62	15	2		2			397	45.0			300		300
Hardwoods	1965	278	23	21	12												334	1.4			4780	1700	6480
	1983	471	125	28	19	2		2									647	3.4			5710	1080	6790
Total	1965	280	23	43	61	35	82	108	101	37	10			2			782	43.5			5240	1850	7090
	1983	471	125	30	50	32	54	93	108	62	15	2		2			1044	48.4			6010	1080	7090

* Age and height determined only in 1965.

Appendix Table B. (Continued)

Forest type: Red Pine Stand No. 6

Species	Year	Diameter class (cm) 5	10	15	20	25	30	35	40	45	50	55	60	65	70	72.5+	Total	Basal area m^2/ha	Age* range years	Height* range m	Seedlings and Sprouts <30 cm	>30 cm	Total
		stems/ha																				stems/ha	
Pinus	1965							7	7								14	1.3	145-155	22-25			
banksiana	1983																-						
Pinus	1965			22	25	20	27	77	74	52	20	7					324	34.5	140-155	11-26			
resinosa	1983			12	20	12	32	37	84	77	22	12					308	38.3					
Pinus	1965							7									7	.5	140	20-23	450	310	770
strobus	1983							7									7	.6			150		150
Picea	1965	10															10	+	30-35	3-4	150		150
glauca	1983	2	7	2													11	.1					
Abies	1965																-				920	150	1070
balsamea	1983																-						
Populus	1965	12	7	7													26	.2	20-50	6-15			
tremuloides	1983	7		2													9	.1					
Betula	1965	47	15	2	7	2		10									83	1.5	40-100	4-20	3080	920	4000
papyrifera	1983	35	44	2	7		2	7	2								99	1.9					
Quercus	1965	20	2	2													24	.1	45-75	3-12			
macrocarpa	1983	52	2	2													56	.2					
Quercus	1965	2															2	+	40	3		150	150
rubra	1983	25															25	+			150		150
Acer	1965			2													2	.1	45	11			
rubrum	1983	10		2													12	.1			150		150
Conifers	1965	10		22	25	20	27	91	81	52	20	7					355	36.3			1530	460	1990
	1983	2	7	14	20	12	32	44	84	77	22	12					326	39.0			150		150
Hardwoods	1965	81	24	13	7	2		10									137	1.9			3080	1070	4150
	1983	129	46	8	7		2	7	2								201	2.3			300		300
Total	1965	91	24	35	32	22	27	101	81	52	20	7					492	38.2			4610	1530	6140
	1983	131	53	22	27	12	34	51	86	77	22	12					527	41.3			450		450

* Age and height determined only in 1965.

Appendix Table B. (Continued)

Forest type: Red Pine Stand No. 7

Species	Year	Diameter class (cm) 5	10	15	20	25	30	35	40	45	50	55	60	65	70	72.5+	Total	Basal area m^2/ha	Age* range years	Height* range m	Seedlings and Sprouts <30 cm	>30 cm	Total
		stems/ha																			stems/ha		
Pinus	1965			2	7	15	57	69	126	64	32	10					382	47.0	135-150	15-29			
resinosa	1983					7	40	57	114	96	20	35	2				371	51.8					
Pinus	1965																-				310		310
strobus	1983																-				150		150
Abies	1965																-				150	150	300
balsamea	1983																-				150		150
Picea	1965																-						
glauca	1983	2															2	+					
Betula	1965	52	37	20													109	.7	25-60	4-16			
papyrifera	1983	49	27	22	10												108	.9					
Populus	1965	22		7													29	.1	15	4-17			
tremuloides	1983	25			2												27	.1					
Populus	1965	10	15	12													37	.4	20-60	5-13			
grandidentata	1983	2	7	7	7												23	.4					
Quercus	1965	15	2														17	+	30-60	3-9		150	150
macrocarpa	1983	82	15														97	.2					
Quercus	1965	2	15	7	2												26	.4	25-60	5-13			
rubra	1983	12	2	7	7												28	.4			150		150
Acer	1965	32															32	+	25-35	5-7	310	150	460
rubrum	1983	64	12	2													78	.3			1390		1390
Tilia	1965																-						
americana	1983																-				150		150
Ulmus	1965																-						
americana	1983	2															2	+					
Fraxinus	1965																-						
nigra	1983	15															15	+			150		150
Prunus	1965																-						
serotina	1983	10															10	+					
Conifers	1965			2	7	15	57	69	126	64	32	10					382	47.0			460	150	610
	1983	2				7	40	57	114	96	20	35	2				373	51.8			300		300
Hardwoods	1965	133	69	46	2												250	1.7			310	300	610
	1983	261	63	38	26												388	2.5			1840		1840
Total	1965	133	69	48	9	15	57	69	126	64	32	10					632	48.7			770	450	1220
	1983	263	63	38	26	7	40	57	114	96	20	35	2				761	54.3			2140		2140

* Age and height determined only in 1965.

Appendix Table B. (Continued)

Forest type: Red Pine Stand No. 36

Species	Year	Diameter class (cm) 5	10	15	20	25	30	35	40	45	50	55	60	65	70	72.5+	Total	Basal area m^2/ha	Age* range years	Height* range m	Seedlings and Sprouts <30 cm	>30 cm	Total
		stems/ha																				stems/ha	
Pinus resinosa	1965				2	2			7	10	10	27	2	7	2		69	15.6	135-145	13-29			
	1983					2				10	12	10	22		7	2	65	16.7					
Pinus strobus	1965					2	2	2	7	10	7	7	2	2	2	7	50	13.9	135-145	18-33	460		460
	1983							2	2	7	2	7	7	2	2	10	41	15.0			150		150
Abies balsamea	1965	2	10	20	22	7	10	7									78	2.6	65-80	10-20	24230	150	24380
	1983		7	2	22	7	10	7	7								62	3.3			1240	310	1550
Picea glauca	1965	2						2	2								6	.7	30-100	3-29	460		460
	1983	2	2					2		2							8	.8				150	150
Betula papyrifera	1965	37	10	2	15	20	7	7	2		2		2				104	4.5	15-125	4-23			
	1983	15	7	7	2	15		2	2								50	1.8					
Populus tremuloides	1965	183	12	2	7	10	12										226	1.9	20-90	5-22	3240	3090	6330
	1983	59	47	2	7	7		2									124	1.4				310	310
Quercus macrocarpa	1965																-				150	150	300
	1983	2															2	+					
Quercus rubra	1965	15									2						17	.6	25-55	4-22			
	1983	22	20	2													44	.2					
Acer rubrum	1965	168				2	2		2								174	.9	25-100	5-16	4780	4170	8950
	1983	295	106	10		2		2									415	1.9			8950	930	9880
Acer saccharum	1965	2															2	+		3			
	1983		2														2	+					
Ostrya virginiana	1965	27	2														29	.1	30-100	5-8		150	150
	1983	12	15														27	.2					
Ulmus americana	1965	2															2	+	25	5	620	310	930
	1983		2														2	+					
Fraxinus nigra	1965																-				310		310
	1983																-						
Prunus serotina	1965																-						
	1983																-					150	150
Conifers	1965	4	10	20	24	11	12	11	16	20	17	34	4	9	4	7	203	32.8			25150	150	25300
	1983	2	9	2	22	9	10	11	9	19	14	17	29	2	9	12	176	35.8			1390	460	1850
Hardwoods	1965	434	24	4	22	32	21	7	4		4		2				554	8.0			9100	7870	16970
	1983	405	199	21	9	24		6	2								666	5.5			8950	1390	10340
Total	1965	438	34	24	46	43	33	18	20	20	21	34	6	9	4	7	757	40.8			34250	8020	42270
	1983	407	208	23	31	33	10	17	11	19	14	17	29	2	9	12	842	41.3			10340	1850	12190

* Age and height determined only in 1965.

Appendix Table B. (Continued)

Forest type: Red Pine Stand No. 38

Species	Year	Diameter class (cm) 5	10	15	20	25	30	35	40	45	50	55	60	65	70	72.5+	Total	Basal area m^2/ha	Age* range years	Height* range m	Seedlings and Sprouts <30 cm	>30 cm	Total
		stems/ha																				stems/ha	
Pinus resinosa	1965		2		15	32	44	62	77	49	10	12					303	33.8	145-155	11-30			
	1983			2	2	22	15	57	64	64	35	12					273	36.8					
Pinus strobus	1965																-				620		620
	1983																-				770		770
Abies balsamea	1965	12	106	181	35	15											349	6.0	70-80	5-24	6330	150	6480
	1983		7	2	10												19	.4			310		310
Picea glauca	1965	2	10		2			2									16	.5	70-80	5-27	150		150
	1983	2															2	+	150				
Betula papyrifera	1965		7	10	2												19	.3	55-80	13-19	2600	310	2930
	1983	69		12	2												83	.4				150	150
Populus tremuloides	1965																-						
	1983																-					150	150
Quercus macrocarpa	1965																-						
	1983	7															7	+				150	150
Quercus rubra	1965																-				150		150
	1983																-				150		150
Acer rubrum	1965																-				620	150	770
	1983	15															15	+			1700	1850	3550
Acer saccharum	1965																-						
	1983																-				310	150	460
Ulmus americana	1965																-						
	1983																-					150	150
Fraxinus nigra	1965																-				310		310
	1983	2															2	+					
Prunus serotina	1965																-						
	1983	10															10	+				460	460
Conifers	1965	14	118	181	52	47	44	64	77	49	10	12					668	40.3			7100	150	7250
	1983	2	7	4	12	22	15	57	64	64	35	12					294	37.2			1080		1080
Hardwoods	1965		7	10	2												19	.3			3700	460	4160
	1983	103		12	2												117	.4			2160	3060	5220
Total	1965	14	125	191	54	47	44	64	77	49	10	12					687	40.6			10800	610	11410
	1983	105	7	16	14	22	15	57	64	64	35	12					411	37.6			3240	3060	6300

* Age and height determined only in 1965.

Appendix Table B. (Continued)

Forest type: Red Pine Stand No. 75

Species	Year	Diameter class (cm) 5	10	15	20	25	30	35	40	45	50	55	60	65	70	72.5+	Total	Basal area m^2/ha	Age* range years	Height* range m	Seedlings and Sprouts <30 cm	>30 cm	Total
		stems/ha																			stems/ha		
Pinus resinosa	1965				7	2	15	15	20	49	37	15					160	25.3	150-155	20-27			
	1983				2	2	7	12	15	27	35	35	15				150	27.9					
Pinus strobus	1965								2								2	.4	145	25	620		620
	1983																-				310		310
Abies balsamea	1965																-				150		150
	1983																-						
Picea glauca	1965																-						
	1983		2														2	+					
Betula papyrifera	1965	134	337	134	20	2											627	5.7	25-55	8-20	1390	1700	3090
	1983	32	146	119	44	10											351	5.0			150		150
Populus tremuloides	1965	7	15	25	20	2											69	1.3	50-55	17-20			
	1983				2		15										17	1.1			150	310	460
Populus grandidentata	1965		12	10	7	2											31	.6	50-55	10-19			
	1983			2	7	7	2										18	.7					
Quercus macrocarpa	1965	2	2														4	+	40-50	9			
	1983	2	2														4	+					
Quercus rubra	1965	37	40	25	22		7	2									133	2.4	35-100	5-18	2010	770	2780
	1983	72	27	27	12	20		7									165	2.8			620	770	1390
Acer rubrum	1965	52	12	7	2	2											75	.5	25-100	4-17	5560	2160	7720
	1983	392	32	7	7		7										445	1.5			8180	620	8800
Acer saccharum	1965																-						
	1983	7															7	+			460	150	610
Tilia americana	1965	7	2														9	+	20-50	4-10			
	1983	12															12	+					
Ostrya virginiana	1965	86															86	.1	50-55	8-9	460	930	1390
	1983	161	12														173	.3			150	1240	1390
Fraxinus pennsylvanica	1965																-						
	1983	7															7	+					
Conifers	1965				7	2	15	15	22	49	37	15					162	25.7			770		770
	1983		2		2	2	7	12	15	27	35	35	15				152	27.9			310		310
Hardwoods	1965	325	420	201	71	8	7	2									1034	10.6			9420	5560	14980
	1983	685	219	155	72	37	24	7									1199	11.4			9710	3090	12800
Total	1965	325	420	201	78	10	22	17	22	49	37	15					1196	36.3			10190	5560	15750
	1983	685	221	155	74	39	31	19	15	27	35	35	15				1351	39.3			10020	3090	13110

* Age and height determined only in 1965.

Appendix Table B. (Continued)

Forest type: Aspen-Birch Stand No. 8

Species	Year	Diameter class (cm) 5	10	15	20	25	30	35	40	45	50	55	60	65	70	72.5+	Total	Basal area m^2/ha	Age* range years	Height* range m	Seedlings and Sprouts <30 cm	>30 cm	Total
		stems/ha																			stems/ha		
Pinus	1965																-				310		310
strobus	1984																-						
Abies	1965																-					150	150
balsamea	1984																-						
Betula	1965		25	25			7										57	1.0	35-55	10-19			
papyrifera	1984	12	12	20			7										51	.9					
Populus	1965	7	44	161	186	193	57	7									655	23.7	15-50	4-23	310	150	460
tremuloides	1984	7			49	69	149	111	20								405	29.0			930	150	1080
Populus	1965	32	12	25	20	37											126	3.2	15-50	6-23		150	150
grandidentata	1984	25	7		7		32	7									78	3.2					
Quercus	1965	25	12	12													49	.3	40-50	4-10			
macrocarpa	1984	25	20	20													65	.5					
Quercus	1965		7						7								14	.9	50	9	770	150	920
rubra	1984	12															12	+			150	150	300
Acer	1965	49	7	12													68	.3	25-50	4-12	2160	770	2930
rubrum	1984	44	44		20												108	.9			4170	150	4320
Acer	1965																-						
saccharum	1984	7															7	+					
Conifers	1965																-				310	150	460
	1984																-						
Hardwoods	1965	113	107	235	206	230	64	7	7								969	29.4			3240	1220	4460
	1984	132	83	40	76	69	188	118	20								726	34.5			5250	450	5700
Total	1965	113	107	235	206	230	64	7	7								969	29.4			3550	1370	4920
	1984	132	83	40	76	69	188	118	20								726	34.5			5250	450	5700

* Age and height determined only in 1965.

Appendix Table B. (Continued)

Forest type: Aspen-Birch Stand No. 25

Species	Year	Diameter class (cm) 5	10	15	20	25	30	35	40	45	50	55	60	65	70	72.5+	Total	Basal area m^2/ha	Age* range years	Height* range m	Seedlings and Sprouts <30 cm	>30 cm	Total
		stems/ha																				stems/ha	
Betula	1965	109	223	164	27	2											525	6.1	30-70	8-22	620	1700	2320
papyrifera	1984	7	32	72	62	15	2										190	4.5					
Populus	1965	15	7	59	119	72	32	2									306	11.0	20-70	5-23	1080	4170	5250
tremuloides	1984	10	2	2	44	82	52	25	10	2							229	13.5			2930	770	3700
Quercus	1965	7		2													9	.1	35-40	6-7		150	150
macrocarpa	1984	2	7	2													11	.6					
Quercus	1965	32	40	44	52	44	7	2	2	2							225	6.6	30-100	3-20	4780	2010	6790
rubra	1984	47	15	22	35	44	25	15	2	2	2						209	7.8			2780	770	3550
Acer	1965	37	7	2													46	.1	25-55	4-13	5560	310	5870
rubrum	1984	89	12	12	2												115	.6			7100	310	7410
Acer	1965	106	2	2		2	2										114	.6	25-100	5-17	8180	1390	9570
saccharum	1984	310	49	7	2		2	2									372	1.6			51850	4480	56330
Tilia	1965	136	47	15	2	2											202	1.1	25-55	6-19	1080	310	1390
americana	1984	94	74	32	15	2	2										219	2.2			620	930	1550
Ostrya	1965	10															10	+	25-35	4-5		150	150
virginiana	1984	27	7														34	.1			620	150	770
Ulmus	1965	22		12													34	.3	45-100	5-13	150		150
americana	1984	7	2	7	7												23	.3			150		150
Fraxinus	1965	2															2	+	30	4	460	460	920
nigra	1984	5															5	+			1240	150	1390
Prunus	1965																-						
serotina	1984																-				310		310
Conifers	1965																-						
	1984																-						
Hardwoods	1965	476	326	300	200	122	41	4	2	2							1473	25.9			21910	10650	32560
	1984	598	200	156	167	143	83	42	12	4	2						1407	31.2			67600	7560	75160
Total	1965	476	326	300	200	122	41	4	2	2							1473	25.9			21910	10650	32560
	1984	598	200	156	167	143	83	42	12	4	2						1407	31.2			67600	7560	75160

* Age and height determined only in 1965.

Appendix Table B. (Continued)

Forest type: Aspen-Birch Stand No. 30

Species	Year	Diameter class (cm) 5	10	15	20	25	30	35	40	45	50	55	60	65	70	72.5+	Total	Basal area m^2/ha	Age* range years	Height* range m	Seedlings and Sprouts <30 cm	>30 cm	Total
		stems/ha																			stems/ha		
Picea	1965																-				150		150
glauca	1984																-						
Betula	1965	12	44	44													100	1.2	30-50	4-19			
papyrifera	1984	25	7	12	20												64	.9					
Populus	1965		82	384	310	32	7										815	18.8	50	9-22	150	150	300
tremuloides	1984	20		32	186	186	62	7	7								500	21.7			930	770	1700
Populus	1965	7	20	62	69	44	12										214	6.3	50	11-24			
grandidentata	1984	12		7	25	57	49	32									182	10.0					
Quercus	1965		7														7	+	45	10			
macrocarpa	1984		7														7	+					
Quercus	1965		12	74	12	2											100	1.9	50	8-18	1230	1230	2460
rubra	1984	37		49	44												130	2.5			620	150	770
Acer	1965	7	12	2													21	.1	25-50	3-12	3700	1700	5400
rubrum	1984	82	12	12													106	.4			4010	1390	5400
Acer	1965	7															7	+	30	5			
saccharum	1984	7	12	7													26	.2			1240	150	1390
Tilia	1965	49	7	7													63	.2	15-50	3-14		150	150
americana	1984	49	25	12													86	.5				310	310
Ostrya	1965	69	20														89	.3	35-50	4-10	310	930	1240
virginiana	1984	230	44	7													281	.7			1080	2010	3090
Ulmus	1965	7															7	+	50	8			
americana	1984																-						
Prunus	1965																-						
serotina	1984																-				310	150	460
Conifers	1965																-				150		150
	1984																-						
Hardwoods	1965	158	204	573	391	78	19										1423	28.8			5390	4160	9550
	1984	462	107	138	275	243	111	39	7								1382	36.9			8190	4930	13120
Total	1965	158	204	573	391	78	19										1423	28.8			5540	4160	9700
	1984	462	107	138	275	243	111	39	7								1382	36.9			8190	4930	13120

* Age and height determined only in 1965.

Appendix Table B. (Continued)

Forest type: Aspen-Birch Stand No. 34

Species	Year	Diameter class (cm) 5	10	15	20	25	30	35	40	45	50	55	60	65	70	72.5+	Total	Basal area m^2/ha	Age* range years	Height* range m	Seedlings and Sprouts <30 cm	>30 cm	Total
		stems/ha																			stems/ha		
Betula	1965	77	183	292	139	22											713	12.1	25-55	7-20			
papyrifera	1984	25	32	119	146	62	20										404	11.6					
Populus	1965	2	10	12	25	35	15	2									101	4.1	15-55	5-21	620	620	1240
tremuloides	1984	64			7	7	20	20	2								120	4.1			620	1390	2010
Populus	1965	2	7		2		2	2									15	.7	15-55	4-21			
grandidentata	1984	25	7	2	2				2	2							40	1.2					
Quercus	1965	20	15	12													47	.4	30-55	5-13			
macrocarpa	1984	10	25	10	7												52	.5					
Quercus	1965	7	12	10	27	27	20	2	2								107	4.5	40-55	6-20	3080	1240	4320
rubra	1984		12	7	7	27	25	22	2	2							104	6.6			1080	150	1230
Acer	1965	10															10	+	25-30	5-7	1550	150	1700
rubrum	1984	10	15														25	.1			4790	150	4940
Acer	1965	2	2														4	+	30-45	6-7	150	150	300
saccharum	1984	22	2	2													26	.1			310	930	1240
Tilia	1965	2															2	+	25	5			
americana	1984	7	2														9	+					
Ostrya	1965	7															7	+	30	4-5			
virginiana	1984	32															32	+				150	150
Fraxinus	1965	2		7													9	.1	45	7-16	1850	930	2780
pennsylvanica	1984	10	2	2	2												16	.2			1080	1390	2470
Prunus	1965				2												2	+	45	15	620	930	1550
serotina	1984	10			2												12	.1				770	770
Conifers	1965																-						
	1984																-						
Hardwoods	1965	131	229	333	195	84	37	6	2								1017	22.0			7870	4020	11890
	1984	215	97	142	173	96	65	42	6	4							840	24.5			7880	4930	12810
Total	1965	131	229	333	195	84	37	6	2								1017	22.0			7870	4020	11890
	1984	215	97	142	173	96	65	42	6	4							840	24.5			7880	4930	12810

* Age and height determined only in 1965.

Appendix Table B. (Continued)

Forest type: Aspen-Birch Stand No. 37

Species	Year	Diameter class (cm) 5	10	15	20	25	30	35	40	45	50	55	60	65	70	72.5+	Total	Basal area m^2/ha	Age* range years	Height* range m	Seedlings and Sprouts <30 cm	>30 cm	Total
		stems/ha																			stems/ha		
Pinus	1965			7		12	7	2									28	1.6	70-75	15-21			
banksiana	1984						15	2									17	1.4					
Pinus	1965	10	40	15	12	20	15	2									114	3.5	50-75	5-22			
resinosa	1984	7	12	15	2	10	22	7	10	2							87	4.6					
Pinus	1965	15	27	52	62	47	25	32	2	10							272	12.5	55-75	5-24	150		150
strobus	1984	2	2	25	47	40	27	22	20	20	7	2	2				216	16.5			150		150
Picea	1965						2										2	.2	75	14	150		150
glauca	1984	2						2									4	.3					
Betula	1965		62	101	101	25	15										304	7.8	60-75	12-22			
papyrifera	1984	2	7	47	69	40	15	2									182	6.6			460		460
Populus	1965	20	2	10	12	32	10	7	2								95	3.8	25-75	6-22	1240	1080	2320
tremuloides	1984	12	2		7	10	20	12	2	7							72	4.8			460	930	1390
Populus	1965	7		2	10	15	12	2									48	2.4	15-75	5-23			
grandidentata	1984	27				7	7	12	7								60	2.7					
Quercus	1965	10	32	47	2												91	1.3	55-75	4-15	150		150
macrocarpa	1984	10	7	32	7												56	.8				150	150
Quercus	1965																-				310		310
rubra	1984																-				310		310
Acer	1965	10															10	+	30-50	4-9	150		150
rubrum	1984		7														7	+			310		310
Acer	1965																-						
saccharum	1984	2															2	+				150	150
Tilia	1965	40	12	20	12												84	1.0	15-75	4-15	310	620	930
americana	1984	126	27	7	15	12											187	1.7			620	1390	2010
Ostrya	1965	32	7														39	.1	25-30	4-5		150	150
virginiana	1984	119	12	2													133	.3				150	150
Ulmus	1965		10		2												12	.1	25-65	8-14			
americana	1984		2		2												4	.1					
Fraxinus	1965	2															2	+		4	1240		1240
nigra	1984	5															5	+			770	310	1080
Conifers	1965	25	67	74	74	79	49	36	2	10							416	17.8			300		300
	1984	11	14	40	49	50	64	33	30	22	7	2	2				324	22.8			150		150
Hardwoods	1965	121	125	180	139	72	37	9	2								685	16.5			3400	1850	5250
	1984	303	64	88	100	69	42	26	9	7							708	17.0			2930	3080	6010
Total	1965	146	192	254	213	151	86	45	4	10							1101	34.3			3700	1850	5550
	1984	314	78	128	149	119	106	59	39	29	7	2	2				1032	39.8			3080	3080	6160

* Age and height determined only in 1965.

Appendix Table B. (Continued)

Forest type: Aspen-Birch Stand No. 47

Species	Year	Diameter class (cm) 5	10	15	20	25	30	35	40	45	50	55	60	65	70	72.5+	Total	Basal area m^2/ha	Age* range years	Height* range m	Seedlings and Sprouts <30 cm	>30 cm	Total
								stems														stems/ha	
Betula	1965	37	173	369	193	40	7										819	16.2	20-65	5-21		460	460
papyrifera	1984	32	20	109	196	74	25										456	13.8			310	620	930
Populus	1965	173	20	2		12	12	10									229	2.9	15-60	4-20		620	620
tremuloides	1984	307	52				10	2	10								381	2.9				310	310
Quercus	1965	12	2	7	2							2					25	1.0	35-70	4-16			
macrocarpa	1984	47	12	7		2						2					70	1.3					
Quercus	1965	7															7	+	25-30	6	310		310
rubra	1984		2	2	2												6	+			150		150
Acer	1965	10	10														20	.1	25-55	7-13		150	150
rubrum	1984	35	12	7	2												56	.3			930	310	1240
Fraxinus	1965																-						
pennsylvania	1984			2													2	+					
Conifers	1965																-						
	1984																-						
Hardwoods	1965	239	205	378	195	52	19	10				2					1100	20.2			310	1230	1540
	1984	421	98	127	200	76	35	2	10			2					971	18.3			1390	1240	2630
Total	1965	239	205	378	195	52	19	10				2					1100	20.2			310	1230	1540
	1984	421	98	127	200	76	35	2	10			2					971	18.3			1390	1240	2630

* Age and height determined only in 1965.

Appendix Table B. (Continued)

Forest type: Aspen-Birch Stand No. 70

Species	Year	Diameter class (cm) 5	10	15	20	25	30	35	40	45	50	55	60	65	70	72.5+	Total	Basal area m^2/ha	Age* range years	Height* range m	Seedlings and Sprouts <30 cm	>30 cm	Total
		stems/ha																				stems/ha	
Abies	1965																-				150	150	300
balsamea	1984																-				150		150
Picea	1965																-					150	150
glauca	1984	12	20														32	.1					
Betula	1965	74	57	10													141	.7	40-55	6-17	310	150	460
papyrifera	1984	94	20														114	.3					
Populus	1965		20	404	392	69	20										905	24.5	45-55	13-23		1240	1240
tremuloides	1984	99		12	136	186	94	32									559	23.4			310	1080	1390
Populus	1965		32	82	32	37											183	4.5	55	12-21			
grandidentata	1984					12	25	7									44	3.0					
Quercus	1965	7	7	7													21	.2	55	6-12		150	150
macrocarpa	1984	25	7	12													44	.3			150		150
Quercus	1965	32	7	7													46	.2	25-55	4-12	770	1080	1850
rubra	1984	210	57	7	7												281	1.0			150	150	300
Acer	1965	37		7													44	.1	25-55	4-13	4630	2470	7100
rubrum	1984	210	20		7												237	.8			14350	930	15280
Acer	1965	7															7	+	20	4			
saccharum	1984	37	20														57	.2			2320	310	2630
Tilia	1965	7															7	+	25		150	1080	1230
americana	1984	7															7	+			770	310	1080
Ostrya	1965	7															7	+	40	4			
virginiana	1984	7															7	+				150	150
Ulmus	1965			7													7	.1	55	10			
americana	1984				7												7	.2			150		150
Fraxinus	1965	7															7	+	55		1390	1700	3090
nigra	1984	99	7														106	.1			2620	620	3240
Conifers	1965																-				150	300	450
	1984	12	20														32	.1			150		150
Hardwoods	1965	178	123	524	424	106	20										1375	30.3			7250	7870	15120
	1984	788	131	31	157	198	119	39									1463	29.3			20820	3550	24370
Total	1965	178	123	524	424	106	20										1375	30.3			7400	8170	15570
	1984	800	151	31	157	198	119	39									1495	29.4			20970	3550	24520

* Age and height determined only in 1965.

Appendix Table B. (Continued)

Forest type: Maple-Basswood Stand No. 14

Species	Year	Diameter class (cm) 5	10	15	20	25	30	35	40	45	50	55	60	65	70	72.5+	Total	Basal area m^2/ha	Age* range years	Height* range m	Seedlings and Sprouts <30 cm	>30 cm	Total
		stems/ha																			stems/ha		
Pinus	1965																-				770		770
strobus	1984																-						
Betula	1965	2	7	32	10	15											66	1.7	25-90	5-23			
papyrifera	1984	2		7	12	2	15										38	1.7					
Populus	1965				10	15	15	25	10	7							82	6.8	75-90	20-24	620	460	1080
tremuloides	1984					2	12	12	20	12	7						65	7.8			620	310	930
Populus	1965	12			12	35	62	35	27	2	2						187	14.6	75-90	21-28			
grandidentata	1984					2	10	49	15	15	2						93	10.8				150	150
Quercus	1965	2		2													4	+	65	5			
macrocarpa	1984			2	2												4	.2					
Quercus	1965			25	44	10	7										86	2.7	65-75	14-21	6170	1080	7250
rubra	1984	2		2	37	22	2	7									72	3.2			2930		2930
Acer	1965		10	22	12	2											46	.9	65-80	12-18	14350	3400	17750
rubrum	1984	15		22	7	12	2										58	1.4			4010		4010
Acer	1965	159	186	124	52												521	5.4	50-75	6-20	100310	16820	117130
saccharum	1984	114	134	101	84	40	2										475	8.0			128860	16820	145680
Tilia	1965	99	27	59	27	2											214	2.4	20-75	5-19	770	1240	2010
americana	1984	69	12	25	32	25	2	2									167	3.3			930	770	1700
Ostrya	1965	173	20														193	.4	55-75	7-9	1700	9260	10960
virginiana	1984	354	37	2													393	.7			2470	7250	9720
Ulmus	1965		2	2													4	.1	55-75	11			
americana	1984		2														2	+					
Fraxinus	1965																-				2010	460	2470
nigra	1984																				310	150	460
Prunus	1965																-				150	460	610
serotina	1984																-				150	150	300
Conifers	1965																-				770		770
	1984																-						
Hardwoods	1965	447	252	266	167	79	84	60	37	9	2						1403	35.0			126080	33180	159260
	1984	556	185	161	174	105	45	70	35	27	9						1367	37.1			140280	25600	165880
Total	1965	447	252	266	167	79	84	60	37	9	2						1403	35.0			126850	33180	160030
	1984	556	185	161	174	105	45	70	35	27	9						1367	37.1			140280	25600	165880

* Age and height determined only in 1965.

Appendix Table B. (Continued)

Forest type: Maple-Basswood Stand No. 21

Species	Year	Diameter class (cm) 5	10	15	20	25	30	35	40	45	50	55	60	65	70	72.5+	Total	Basal area m²/ha	Age* range years	Height* range m	Seedlings and Sprouts <30 cm	>30 cm	Total
		stems/ha																			stems/ha		
Pinus	1965													2		2	4	2.9	160	30	460		460
strobus	1984																-						
Abies	1965																-				310	150	460
balsamea	1984																-						
Picea	1965	10															10	+	20-40	3			
glauca	1984	22															22	+					
Betula	1965			25	37	22	10	2									96	3.6	70-90	14-24			
papyrifera	1984			12	12	22	20	2	2								70	3.8					
Populus	1965	2				2	10	12	17								43	4.4	90-110	22-27	150		150
tremuloides	1984							2	10	7	2						21	3.0					
Quercus	1965		2	7	2	2	2		2								17	1.0	70-205	5-22	150	150	300
macrocarpa	1984			2		2			2								6	.6					
Quercus	1965																-				2160	460	2620
rubra	1984																-				1240	150	1390
Acer	1965	37	47	74	37	25			2								222	4.4	30-160	4-19	87810	14200	102010
saccharum	1984	159	10	37	64	25	22	2									319	6.0			73610	14970	88580
Tilia	1965	94	22	44	77	72	40	12	15								376	13.4	20-135	4-22	930	460	1390
americana	1984	44	37	27	44	52	57	40	15	7	2						325	16.3			2320	310	2630
Ostrya	1965	771	49														820	1.1	35-90	5-12	930	7250	8180
virginiana	1984	250	20	2													272	.5			310	2310	2620
Carpinus	1965																-						
caroliniana	1984	2															2	+					
Ulmus	1965		12	7	7	7	15										48	2.0	70-160	8-17	8020	3400	11420
americana	1984	2	2	2	2	2	10	12									32	2.3			11420	310	11730
Fraxinus	1965	2	15	12	10	2	2										43	1.0	25-90	6-21	34880	5860	40740
nigra	1984			10	10	2	7										29	1.2			3400	2620	6020
Conifers	1965	10												2		2	14	2.9			770	150	920
	1984	22															22						
Hardwoods	1965	906	147	169	170	132	79	26	36								1665	30.9			135030	31780	166810
	1984	457	69	92	132	105	116	58	29	14	4						1076	33.7			92300	20670	112970
Total	1965	916	147	169	170	132	79	26	36					2		2	1679	33.8			135800	31930	167730
	1984	479	69	92	132	105	116	58	29	14	4						1098	33.7			92300	20670	112970

* Age and height determined only in 1965.

Appendix Table B. (Continued)

Forest type: Maple-Basswood Stand No. 22

Species	Year	Diameter class (cm) 5	10	15	20	25	30	35	40	45	50	55	60	65	70	72.5+	Total	Basal area m^2/ha	Age* range years	Height* range m	Seedlings and Sprouts <30 cm	>30 cm	Total
		stems/ha																			stems/ha		
Pinus resinosa	1965												2				2	.9	160	26			
	1984												2				2	.9					
Pinus strobus	1965																-				1080		1080
	1984																-				310		310
Abies balsamea	1965	74	151	119	106	49	12	7									518	11.1	50-70	5-23	3700	310	4010
	1984		15	37	54	25	27	7	2								167	6.9			770		770
Picea glauca	1965																-						
	1984	20															20	+					
Betula papyrifera	1965	10	20	22	7	7											66	1.1	65-80	5-22	770	150	920
	1984	15	7	7	12	7	2										50	1.1					
Populus tremuloides	1965				10	12	7	27	25	22	10	7	2				122	15.2	75-110	18-27	1700	770	2470
	1984	126	7			2	2		10	15	12	10	2	7			193	12.0			1540	460	2000
Quercus macrocarpa	1965	2	22	47	7	2	7										87	1.8	60-160	4-20	150		150
	1984		12	27	25	7		10									81	2.5					
Quercus rubra	1965				2												2	.1		16	1390	310	1700
	1984	2					2										4	.2			1700	150	1850
Acer rubrum	1965			12	12	12											36	1.2	70-80	13-18	45830	18210	64040
	1984	44	2		12	10	12										80	1.9			23920	6330	30250
Acer saccharum	1965	10		2	2												14	.2	20-80	5-16	2780	4010	6790
	1984	307	10	2													319	.6			17900	11570	29470
Tilia americana	1965	47	7	12	22	12											100	1.6	20-130	4-17	460	930	1390
	1984	37	12	12	2	20	10	2									95	2.3			930	770	1700
Ostrya virginiana	1965	84	35														119	.4	80	4-11	2010	3090	5100
	1984	223	47	7													277	.8			2010	2620	4630
Ulmus americana	1965	2	25	15													42	.5	70-80	4-16	310	150	460
	1984	2	10	15	7												34	.6			310	150	460
Fraxinus pennsylvanica	1965		40	27	9												76	1.1	80	11-17	5560	3550	9110
	1984	15	12	35	9	7											78	1.4			4170	3090	7260
Carpinus caroliniana	1965																-						
	1984	37															37	+					
Conifers	1965	74	151	119	106	49	12	7					2				520	12.0			4780	310	5090
	1984	20	15	37	54	25	27	7	2				2				189	7.8			1080		1080
Hardwoods	1965	155	149	137	71	45	14	27	25	22	10	7	2				664	23.2			60960	31170	92130
	1984	808	119	105	67	53	28	12	10	15	12	10	2	7			1248	23.4			52480	25140	77620
Total	1965	229	300	256	177	94	26	34	25	22	10	7	4				1184	35.2			65740	31480	97220
	1984	828	134	142	121	78	55	19	12	15	12	10	4	7			1437	31.2			53560	25140	78700

Appendix Table B. (Continued)

Forest type: Maple-Basswood Stand No. 50

Species	Year	Diameter class (cm) 5	10	15	20	25	30	35	40	45	50	55	60	65	70	72.5+	Total	Basal area m^2/ha	Age* range years	Height* range m	Seedlings and Sprouts <30 cm	>30 cm	Total
		stems/ha																			stems/ha		
Pinus	1965								2		2	2	2			5	13	5.7	185-260	22-30			
resinosa	1983									2		2	2	2		2	10	5.2					
Pinus	1965														2	15	17	10.6	185-195	28-35	3400		3400
strobus	1983															12	12	7.2					
Betula	1965		2	10	10	7	12	7									48	2.3	60-100	12-22			
papyrifera	1983				2	2		12	2								18	1.9					
Populus	1965			2	10	20	27	20	7	7	2	2					97	8.2	70-100	18-24	770	1850	2620
tremuloides	1983				7	2	10	12	2			2					35	3.5			150	310	460
Populus	1965					2	2		7								11	1.2	80	23		150	150
grandidentata	1983						2			2							4	.8					
Quercus	1965		2														2	+	80	11			
macrocarpa	1983			2													2	+			150		150
Quercus	1965			15	10	2	12										39	1.6	75-85	14-20	2320	460	2780
rubra	1983				7	7	7	2	2								25	1.7			2160	310	2470
Acer	1965		7	12													19	.2	80	14-15	4780	770	5550
rubrum	1983	2		12													14	.2			150		150
Acer	1965	218	283	201	89	32	7	2									832	11.2	65-160	4-19	181020	43060	224080
saccharum	1983	94	181	193	139	84	12	10									713	15.4			174380	34260	208640
Tilia	1965	10		12	10	2	7										41	1.2	15-175	3-20	620	1080	1700
americana	1983	10		7	2	10	7	2									38	1.5			1080	1240	2320
Ostrya	1965	10	7			2											19	.2	70-75	6-10	150	620	770
virginiana	1983	49															49	+				1080	1080
Ulmus	1965			2		7											9	.3	80-185	12-16	310		310
americana	1983			2		7											9	.4					
Fraxinus	1965																-				620		620
nigra	1983																-				150	150	300
Prunus	1965																-						
serotina	1983																-				150	150	300
Conifers	1965								2		2	2	2		2	20	30	16.3			3400		3400
	1983									2		2	2	2		14	22	12.4					
Hardwoods	1965	238	301	254	129	74	67	29	14	7	2	2					1117	26.4			190590	47990	238580
	1983	155	181	216	157	112	38	38	6	2		2					907	25.4			178370	37500	215870
Total	1965	238	301	254	129	74	67	29	16	7	4	4	2		2	20	1147	42.7			193990	47990	241980
	1983	155	181	216	157	112	38	38	6	4		4	2	2		14	929	37.8			178370	37500	215870

* Age and height determined only in 1965.

Appendix Table B. (Continued)

Forest type: Maple-Basswood Stand No. 56

Species	Year	Diameter class (cm) 5	10	15	20	25	30	35	40	45	50	55	60	65	70	72.5+	Total	Basal area m^2/ha	Age* range years	Height* range m	Seedlings and Sprouts <30 cm	>30 cm	Total
		stems/ha																			stems/ha		
Pinus	1965							2	2		15		7	10	7	5	48	14.7	110-180	21-34	7560	150	7710
strobus	1983									7	7	2	2	2	7	15	42	15.3					
Betula	1965		7	22	32	27	2	2									92	3.3	45-65	14-23			
papyrifera	1983			7	7	10	10		2								36	1.9					
Populus	1965		2		10	2	2	7									23	1.3	50-65	15-24			
tremuloides	1983				2	2	2			2							8	.9			310	150	460
Quercus	1965	2	37	37					2	7			2		2		89	4.5	55-345	7-24	1390	1390	2780
macrocarpa	1983		15	25	2					10			2				54	3.2					
Quercus	1965			32	32	62	2	2									130	5.2	45-65	12-22	8180	150	8330
rubra	1983			2	22	37	47	7									115	6.6			2780		2780
Acer	1965	7	27	7													41	.3	35-65	9-18	6790	310	7100
rubrum	1983	10	2	10													22	.2			150		150
Acer	1965	111	248	139	52	2	2		2		2						618	7.8	45-100	3-23	61880	10960	72840
saccharum	1983	86	161	131	62	22	2					2					466	7.9			65740	11110	76850
Tilia	1965	15	15	27	25	10	2										94	2.1	10-65	3-22	310		310
americana	1983	20	10	7	25	12	10	2									86	2.6					
Ostrya	1965	255	47	2													304	.9	35-100	4-13	1540	770	2310
virginiana	1983	109	25														134	.4			770	1240	2010
Ulmus	1965	2	2					2									6	.5	50-220	10-23			
americana	1983								2								2	.5					
Fraxinus	1965			2													2	.1	55	18			
pennsylvanica	1983				2												2	.1					
Conifera	1965							2	2		15		7	10	7	5	48	14.7			7560	150	7710
	1983									7	7	2	2	2	7	15	42	15.3					
Hardwoods	1965	452	385	268	151	103	10	11	6	7	2		2		2		1399	26.0			80090	13580	93670
	1983	225	213	182	122	83	71	9	2	14		2	2				925	24.3			69750	12500	82250
Total	1965	452	385	268	151	103	10	13	8	7	17		9	10	9	5	1447	40.7			87650	13730	101380
	1983	225	213	182	122	83	71	9	2	21	7	4	4	2	7	15	967	39.6			69750	12500	82250

* Age and height determined only in 1965.

Appendix Table B. (Continued)

Forest type: Maple-Basswood Stand No. 62

Species	Year	Diameter class (cm) 5	10	15	20	25	30	35	40	45	50	55	60	65	70	72.5+	Total	Basal area m^2/ha	Age* range years	Height* range m	Seedlings and Sprouts <30 cm	>30 cm	Total
		stems/ha																			stems/ha		
Pinus	1965													2			2	1.0	190	25			
resinosa	1984														2		2	1.2					
Pinus	1965													2		5	7	4.6	195-205	29-32	620	150	770
strobus	1984														2	2	4	3.3					
Abies	1965																-				150		150
balsamea	1984																-				150		150
Picea	1965	2															2	+	35	3			
glauca	1984	20	7														27	.1					
Betula	1965	2	12	37	52	15	7										125	3.7	50-80	10-24			
papyrifera	1984		2	7	25	27	15										76	3.4					
Populus	1965			2	10	40	47	44	15			2					160	12.8	75-80	18-26	2010	2160	4170
tremuloides	1984					7	10	25	15	12							69	7.5			310	150	460
Quercus	1965			2		2											4	.2	80	19			
macrocarpa	1984			2													2	.1					
Quercus	1965			10	25	22	22	2		2							83	4.5	75-80	13-26	10960	1080	12040
rubra	1984			2	7	15	25	10	12		2						73	6.0			2620	1080	3700
Acer	1965	2	15	37	7												61	.9	55-80	8-17	17280	3090	20370
rubrum	1984	7		12	20	7											46	1.2			8640	1080	9720
Acer	1965	173	156	131	52	12											524	6.0	50-80	6-17	86570	12650	99220
saccharum	1984	109	121	96	111	32	10										479	8.6			154170	19140	173310
Tilia	1965	37	27	27	27	10	7										135	2.6	20-80	4-20	1390	1390	2780
americana	1984	59	10	12	20	27	7	7									142	3.4			1700	1540	3240
Ostrya	1965	57	20														77	.3	30-80	7-12	770	1700	2470
virginiana	1984	101	22														123	.3			930	2310	3240
Prunus	1965																-				150	310	460
serotina	1984																-					150	150
Conifers	1965	2												4		5	11	5.6			770	150	920
	1984	20	7												4	2	33	4.6			150		150
Hardwoods	1965	271	230	246	173	101	83	46	15	2		2					1169	31.0			119130	22380	141510
	1984	276	155	131	183	115	67	42	27	12	2						1010	30.5			168370	25450	193820
Total	1965	273	230	246	173	101	83	46	15	2		2		4		5	1180	36.6			119900	22530	142430
	1984	296	162	131	183	115	67	42	27	12	2				4	2	1043	35.1			168520	25450	193970

* Age and height determined only in 1965.

Appendix Table B. (Continued)

Forest type: Maple-Basswood Stand No. 68

Species	Year	Diameter class (cm) 5	10	15	20	25	30	35	40	45	50	55	60	65	70	72.5+	Total	Basal area m^2/ha	Age* range years	Height* range m	Seedlings and Sprouts <30 cm	>30 cm	Total
		stems/ha																			stems/ha		
Pinus resinosa	1965															2	2	1.5	235	27			
	1984															2	2	1.5					
Pinus strobus	1965														2		2	1.2	180	28			
	1984														2		2	1.3					
Betula papyrifera	1965	2	32	49	52	20	2										157	3.9	50-80	12-22	770	150	920
	1984		2	10	15	25	10	2									64	2.7					
Populus tremuloides	1965			2	2	20	20	22	2	2							70	5.4	80	17-23	1080	2780	3860
	1984						7	15	7		2						31	3.5				460	460
Quercus macrocarpa	1965				2		2			7		2					13	2.2	80-265	18-23			
	1984					2		2			7	2					13	2.5			310		310
Quercus rubra	1965				2	12	10	2									26	1.7	75-80	17-20	4780	770	5550
	1984					2	15	7	2								26	2.3			2010		2010
Acer saccharum	1965	186	233	210	72	7		2									710	8.9	50-80	6-19	227320	48760	276080
	1984	96	161	136	149	49	2										593	11.3			102620	25160	127780
Tilia americana	1965	22	22	40	49	37	7										177	4.7	15-100	3-20		150	150
	1984	40	10	20	20	37	37	2	2								168	6.2			770	310	1080
Ostrya virginiana	1965	171	35														206	.6	55-80	5-11	2160	11570	13730
	1984	181	32														213	1.7			2160	10190	12350
Ulmus americana	1965		2	15		2											19	.5	75-80	14-18		150	150
	1984			7	2		2										11	.5				150	150
Fraxinus nigra	1965			2													2	.1	80				
	1984																-						
Carpinus caroliniana	1965																-						
	1984																-					150	150
Prunus serotina	1965																-				150		150
	1984																-						
Conifers	1965														2	2	4	2.7					
	1984														2	2	4	2.8					
Hardwoods	1965	381	324	318	179	98	41	26	2	9		2					1380	28.0			236260	64330	300590
	1984	317	205	173	186	115	73	28	11		9	2					1119	30.7			107870	36420	144290
Total	1965	381	324	318	179	98	41	26	2	9		2			2	2	1384	30.7			236260	64330	300590
	1984	317	205	173	186	115	73	28	11		9	2			2	2	1123	33.5			107870	36420	144290

* Age and height determined only in 1965.